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THE USE OF LIME ON NEW ZEALAND PASTURES.*

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Introduction.

In this paper the word "lime" is restricted in its application to burnt lime, slaked lime, and ground limestone, and does not include other calcium compounds such as phosphate or nitrate, which are applied on account of a direct manurial value. Further, any reference to the beneficial action of liming is made on the assumption that its use coincides with or is followed by applications of phosphate, and at the outset it should be emphasized that the use of lime without phosphate is not generally advocated.

The Extent of Liming.

The use of lime in New Zealand is increasing rapidly, and the total quantity of "agricultural lime" transported by rail in the year ending 31st March, 1935, was nearly 245,000 tons. This quantity was approximately double that carried in 1927–28.

A comparison of figures relating to the areas top-dressed and limed in each land district with the quantities of lime carried by rail indicates that Otago and Southland are by far the greatest users of lime in proportion to the amount of grassland top-dressed. It is also indicated that in these districts there is a tendency to apply lime in large quantities of from 10 cwt. to 1 ton per acre as opposed to smaller quantities of from 3 cwt. to 7 cwt. per acre applied in the more northerly land districts. Of the latter, Canterbury, Westland, and Auckland rank highest as regards the quantities of lime used, while in Gisborne, Hawke's Bay, and Marlborough respectively the proportion of grassland limed is less than 20 per cent. of that top-dressed.

While there has been no definite trend during recent years in the South Island, there has been a general increase each year since 1927–28 in the North Island, and here the quantity transported by rail last season was four times that carried in the season mentioned above.

* Substance of paper presented at Fourth Conference of the New Zealand Grassland Association, Christchurch, August, 1935.

Reasons for Use of Lime.

In 1931 Connell(1) drew attention to the rapidly increasing quantities of lime used, and suggested that lowering of expenditure in a time of financial stress was the cause which led to some of the increase. Although the diminution in the quantities of fertilizers used during the period cited lends support to this hypothesis, it should be borne in mind that certain published reports(2), (3), (7) on the effect of lime may also have had some influence. It is true that the reports which gave prominence to the visible effect of lime concerned the South Island, but other, and probably far more telling, aspects of the use of lime in the North Island concerned the mineral-content of the herbage and the effect of lime deficiency on the health of stock—a factor quite as potent in some districts as increased production.

The underlying factor behind the use of lime on many farms is the belief that it not only possesses a subtle influence on the chemical composition of the herbage, but also reduces the soil acidity. The cheapness of the material, often as low as 10s. per ton, is a further inducement to apply lime, and the fact that the Government encourages its wholesale use by giving free railage up to 100 miles still further develops a lime "complex" in the mind of the New Zealand farmer.

Actually, New Zealand farmers, apart from those in one or two districts, have less incentive to lime than farmers in the Northern Hemisphere. "Mat" on grassland, a condition requiring a large application of burnt lime for its eradication, is comparatively unknown in the Dominion. Although clovers are generally stimulated by applications of lime in New Zealand, in some districts they thrive on soils having a lime-requirement much greater than that tolerated by clovers in Europe. In other countries much stress is placed on the suppression of beneficial soil bacteria under acid conditions, and the absence of *Azotobacter* in particular is generally viewed with much concern. In an examination of fifteen New Zealand soils in connection with the "soil plaque" method of soil analysis Reid(4) found *Azotobacter* spp. to be normally present in only one sample (pH 7·5), so that apparently *Azotobacter* is not well distributed in our soils, although nitrogen fixation does not seem to suffer on that account. Scrivener(5) remarked on the apparent failure of existing methods of determining lime-requirement under New Zealand conditions, but later(6) suggested a modified formula which, when applied to certain soil-tests, appeared to correlate these with responses in the field.

The fact remains that in New Zealand we cannot be guided by many of the theoretical considerations, laboratory procedure, or ecological conditions governing lime and its use in other countries. Our only guide to date has been actual field trials carried out either by the farmer or by the State.

Field Trials.

The Fields Division of the Department of Agriculture has conducted throughout New Zealand since 1924 approximately 600 simple observational trials in which lime plots (chiefly calcium carbonate) were included. Generally lime alone was compared with no lime, and

fertilizers—chiefly superphosphate and potash—with lime were compared with the same fertilizers on unlimed ground. Most of the results have been published(7), and are here summarized briefly.

In some of the experiments marked responses occurred, in others little or no visible benefit was derived either from lime alone or lime in combination with phosphates.

As superphosphate has been used in practically all these trials, the effect of lime might be considered relative to that of superphosphate in the following groups :—

1. *Superphosphate alone gives poor or only fair results ; lime alone may give fair to good results , superphosphate with lime gives good to very good results.*

Growth of both grasses and clovers is poor on unlimed ground, but lime in conjunction with superphosphate induces a striking improvement in white clover, which is often reflected in the health and vigour of the rye-grass. The palatability of the limed plots is generally better, as shown in the grazing. Liming is essential on this class of land, although in some cases it is quite possible that basic slag used repeatedly might obviate the necessity of liming. This is open to question, however, in districts where lime responses of such magnitude occur, since, in the majority of cases where basic-slag plots were included, liming improved the appearance of the latter as well as of the superphosphate plots.

The proportion of experiments falling in this group, together with the districts in which the responses occurred, are as follow :—

District.	Soils.	Percentage of Experiments in Group 1.
North Auckland ..	Clays or silts	92
North Auckland ..	Ironstone (laterite) ..	100 (2 experiments).
North Auckland ..	Volcanic	71
Marlborough	Loams and sandy loams ..	33
Westland	Miscellaneous	90
North Canterbury ..	Silt loams and loams ..	43
Christchurch	Sandy silts, silt loams ..	41
Mid-Canterbury ..	Fine sandy silts, silt loams ..	61
South Canterbury ..	Clay loams, silt loams ..	30
South Otago	Miscellaneous	33
East Southland ..	Miscellaneous	60
West Southland ..	Miscellaneous	11
Nelson	..	Pakihi lands.

The small proportion of experiments showing relatively good responses from superphosphate plus lime as compared with superphosphate in South Otago and Western Southland—districts in which lime is used freely and in large quantities—may be due to the fact that sufficient lime had already been applied. It should be stated that the fertilizers and lime were top-dressed on existing pasture, and that in the two districts last mentioned the general farming practice is to sow down to grass with 1 ton per acre of carbonate of lime.

In the above group might be included a trial at Ruakura Farm of Instruction under the mowing-and-grazing technique evolved by

Hudson. This experiment was laid down in July, 1934, on newly-sown pasture, and the soil may be roughly described as a peat loam. Results to 19th June, 1935—*i.e.*, for approximately ten months—are markedly in favour of the lime treatments, as indicated by the following :—

Treatment.	Relative Production of Dry Matter. (No Manure = 100.)
No manure	100
Superphosphate, 4 cwt. per annum	116
Superphosphate, 4 cwt. per annum plus lime, 1 ton (initial)	137
Superphosphate, 4 cwt. per annum plus lime, 10 cwt. (initial)	130

It is interesting to record that an observational trial on a true peat soil at Ruakura suggests results in accord with the above.

2. Superphosphate gives good results, but better results are obtained from superphosphate with lime.

In the trials of this group the lime responses are generally spasmodic —*i.e.*, they are obvious only at certain times of the year, and then chiefly in the autumn, when white-clover growth is more pronounced. Moreover, the experiments are, in most cases, on better pastures than those in Group 1. It is indicated in these experiments that lime is not essential for the establishment and maintenance of reasonable pasture, but that lime as an adjunct to superphosphate increases production. It does not necessarily follow that the use of lime under these conditions is profitable, since it might be found that money spent in extra phosphate rather than in liming gives greater returns. Further, basic slag, under certain conditions, may be a better proposition than superphosphate plus lime.

Experimental results falling in Group 2 have been obtained in most districts throughout the Dominion, but more especially in the King-country, South Taranaki, Wanganui, Marton, Wairarapa, and Northern Manawatu districts of the North Island and Banks Peninsula in the South Island, in addition to those districts mentioned under Group 1.

In the category of Group 2 may be placed a trial under the mowing and grazing technique at Marton Experimental Area. This trial was laid down in September, 1932, and results up to 21st June, 1935, after approximately two years nine months of trial, show the following :—

Treatment.	Relative Production of Dry Matter.
No lime	100
Carbonate of lime, 2 tons per acre (initial) ..	112·5
Carbonate of lime, 1 ton per acre (initial) ..	107·9

Although in this trial there is no comparison of superphosphate with no manure, other experiments on the farm show responses from superphosphate which can be classified as good.

3. The addition of lime to superphosphate causes no appreciable improvement.

Although isolated trials in the undermentioned districts may show slight but fleeting responses from lime, the majority of the experiments do not indicate any improvement in the amount of growth, composition

of sward, or palatability of herbage. In fact, the limed plots have, on occasion, been inferior in general vigour of herbage in some of the experiments.

Districts in which no general apparent benefit has been derived from lime used in experiments are—Rotorua and Southern Waikato (pumice soils), Hauraki Plains (clay soils), Southern Poverty Bay, Hawke's Bay, Southern Manawatu, North Otago, and Central Otago.

Haying Trials.

During the seasons 1924 to 1929 a large number of experiments were carried out in which the production of herbage from various treatments, including lime, was cut and weighed as for a hay crop. Only seventeen experiments out of forty-six, or 37 per cent., of the trials gave any appreciable increase in bulk from the lime plus superphosphate plots as compared with superphosphate alone. Most of the experiments referred to were in the South Island and in districts in which subsequent observational trials indicated that liming caused appreciable benefit. The weakness of trials in which hay-weights are the sole criterion of improvement is in the fact that the hay crop represents only a portion of the growth for the whole year, and, further, that any increases due to a particular treatment are obtained during the period of maximum production. Since, as will be shown later, lime tends to increase production most during periods of low production, it is considered that the results of haying trials might even be misleading when the effects of liming are under investigation.

The Effect of Lime at Various Times of the Year.

In the liming trial at Marton referred to previously, one of the most marked features in the increased production from liming (all plots being phosphated) was the relatively high response during periods of low production, particularly in the dry months of the late summer and in autumn, and the relatively low response during periods of high grassland production. In connection with the foregoing statement regarding hay-weights, the increases due to the application of 2 tons per acre of lime in the "haying period" (taken as from 1st October to 31st December) as compared with the remainder of the year are as follow :—

	Percentage Increases of Lime over No Lime : Dry Matter. Per Cent.
"Haying period," 1932–33	9·2
Remainder of year 1933	16·6
"Haying period," 1933–34	11·6
Remainder of year 1934	24·1
"Haying period," 1934–35	1·4
January to June, 1935	9·3

The results of this trial show, incidentally, that even where lime gives a moderate response the effect at times is apparent very soon after application. It is of interest that in another experiment alongside the above, basic slag is giving results slightly inferior to those from superphosphate, and the addition of lime to basic slag has given a slight increase over basic slag without lime.

Lime-content of Herbage.

As the herbage from the above trial was analysed periodically it is possible to ascertain whether or not liming affected the lime-content of the herbage. For the first eight months of the trial the lime (CaO) content of the herbage from the no-lime plots averaged 1·15 per cent. of the total dry matter, while on the limed (1 ton carbonate per acre) plots the CaO content was 1·24 per cent.*

In view of the fact that the herbage from the limed plots contained a greater proportion of white clover, which, according to Doak(8), contains almost twice as much lime (CaO) as rye-grass, the increased CaO content of the herbage due to liming is not unexpected. In discussing the effect of superphosphate on the chemical composition of herbage, Hudson and Doak(9) stated " It should be remembered that the increased lime-content is not wholly due to an increased percentage of clover in the mown herbage, but is partly due to an increased percentage of lime in both the grass and the clover."

This lends support to the hypothesis that liming increases the CaO content of the herbage, apart from the change in botanical composition, just as potash applications in another trial(10) increased the potash (K_2O) content of herbage without changing the sward or even increasing yield to any appreciable extent.

The Duration of Effect of Liming.

The effect of lime is said to persist for many years, particularly on grassland. This idea is so well established in Great Britain that in some districts an ingoing tenant must pay an outgoing tenant one-eighth of the cost of lime applied seven years previously on the assumption that the effect of lime on grassland lasts for eight years after application. As the leaching of lime from the soil depends to a large extent on rainfall, one expects the lime to be effective for a considerably less period in wet districts, particularly where the soil is of a light, porous nature. At Marton, in the liming experiment referred to previously, records of the free calcium carbonate ($CaCO_3$) in the top two inches of soil suggest that the latter is lost readily from this horizon, only about half of the $CaCO_3$ applied being recoverable after the first year. Since calcium compounds have so many functions in the soil —*e.g.*, preservation of soluble phosphate subsequent to superphosphate applications, the alleged liberation of phosphates and potash which are not immediately available to the plant, and the effect on the mechanical condition of the soil, in addition to the reduction of soil acidity—it appears that the only satisfactory method of gauging loss of lime from the soil is from actual drainage determinations. The term of years over which lime is effective depends considerably upon the initial effect on the pasture. In several of the observational trials laid down in Canterbury the effect of 1 ton of lime applied in 1928 was clearly visible in 1935—seven years after application. At Winton Experimental Farm lime applied at a ton per acre across several paddocks in 1924 was clearly visible up to a year ago in the general improved vigour of various crops sown, particularly turnips. In this case the effect of lime was not apparent until about two years after application. It is hoped that

* Figures kindly supplied by Mr. B. W. Doak.

some exact information as to the duration of the response to liming may be obtained from experiments under mowing and grazing at Marton and Ruakura.

Forms of Lime.

There does not appear to be any advantage in using burnt lime on grassland as opposed to carbonate. Burnt or slaked lime is recommended for certain purposes on arable crops—*e.g.*, club-root control—but in view of the extra cost entailed by burning, carbonate of lime is more economical on grassland, and experimental evidence to date indicates it is quite as efficient as burnt lime when an equivalent amount of CaO is applied in each case.

Availability of Carbonate of Lime.

Much has been said regarding the extent to which limestone should be ground. In the United States of America particularly there seems to be considerable divergence of opinion as to the best degree of fineness commensurate with cost of grinding. Grimmett and Denz(11) reviewed the question of fineness of grinding and other factors relating to availability in New Zealand.

Some time ago the writer and others(12) investigated the effect of various commercial samples of carbonate of lime in alleviating the germination-injury to turnip-seed caused by superphosphate. It was found that whereas many brands were fairly efficient in this respect a few were extremely poor, notwithstanding the fact that they contained a high percentage of calcium carbonate. Fineness of grinding was found to be of importance, although when each of the limestones used was reduced to a fairly high degree of fineness there still remained appreciable differences in performance which could not be explained by variations in the calcium carbonate content or the hardness of the parent rock. The trials focussed attention on the very considerable differences in the degree of fineness of ground limestones turned out by various quarries. Over 40 per cent. of some samples is retained on a 30-mesh sieve—which is a relatively coarse grade—while others can produce the material with less than 20 per cent. retained on a 30-mesh sieve. At the other end of the scale some commercial samples contain about 50 per cent. of material passing a 120-mesh sieve, and these can be purchased at less cost than others containing only about 15 per cent. of this fine fraction.

The question arises, are these differences in fineness of any real moment, since it is likely that the coarser particles become available ultimately under the action of rainfall and weathering over a period of years? It has been suggested in some quarters that a fair proportion of coarser material may actually be an advantage since less leaching of lime is likely to occur. On the other hand, money spent on coarsely ground limestone represents capital lying idle for a number of years, and the modern farmer tends to depart from the old established custom of manuring for posterity. Quick returns from any operation are now looked for, and it is suggested that just as one applies quickly acting fertilizers to obtain a large initial response, so should frequent applications of finely ground limestone be made rather than infrequent dressings of relatively coarse material.

Conclusion.

The present paper is a brief survey of the practice of liming on New Zealand grasslands. It has been indicated from the results of observational trials on grassland that liming increases the efficiency of phosphates, particularly superphosphate, over wide areas of New Zealand. The resultant increased production is obtained chiefly during a period of normally low production, and, where effective, is therefore another of the means of getting a more even distribution of production over the year.

The effect of lime on pasture has been found to persist for several years in some districts in spite of the frequently made assertions that calcium carbonate is leached rapidly from the soil.

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SEEDLESS BARBERRY IN SOUTHLAND.

Relative to the statement about the use of seedless barberry in Southland which appeared in the September number of this *Journal*, page 190, a correspondent at Otara has kindly supplied the appended information:—

"About ten or twelve years ago, perhaps more, I obtained cuttings of this plant from Matamata, Waikato, and had no difficulty in getting them to grow, but have found them to be very slow to develop, and the change of climate seems to have held them back so much that I have not considered them at all profitable for hedge-work here at Woodlands. Further, contrary to the northern experience, I have found that stock particularly relish the young shoots, perhaps because of our later spring and scarcity of green feed in the time the young shoots are available. Plants I have within reach of stock are well kept back because of this, and are still very small, while a sheltered plant is now 7 ft. or 8 ft. high, and I have been watching to see if it will improve its growth with time in the South.

"Some plants I gave to a relative on the Taieri Plain, planted on heavier land than mine, did not show material difference in results.

"Summed up, I would say that the growth has been too slow, and that the need of fencing has so far ruled seedless barberry out as a profitable fence for my use."

THE OCCURRENCE OF SPOTTED-WILT ON TOMATOES IN NEW ZEALAND.

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THE name "spotted-wilt" was first used by Brittlebank (1919) in Australia to describe a disease of tomatoes observed near Melbourne during the 1915–16 season. This disease, which has since been shown to be caused by a virus (Pittman, 1927), has been studied in detail by Samuel, Bald, and Pittman (1930) and Bald and Samuel (1931). Spotted-wilt has been recorded also from England (Smith, 1931; Ainsworth, 1933) and from North America (Doolittle and Sumner, 1931; McWhorter, 1934).

For a number of years a serious disease, known locally as "stripe" or "brown-top," the symptoms of which closely resemble those of spotted-wilt, has been present in tomato crops grown in the Hutt Valley, New Zealand. During the 1934–35 season it has made its appearance in the Manawatu district.

SYMPTOMS.

On out-door tomatoes the first noticeable symptom of the disease is a slightly bunched appearance of the growing-points (Figs. 1 and 2). This appearance is caused by cessation of growth, downward curling of the developing leaves, and inrolling of the individual leaflets. At this stage the older leaves appear normal, but on the young leaves bronze markings are apparent, and these form the most characteristic symptom of the disease. The leaf markings may vary in colour from light bronze to almost black. They may occur as small isolated areas, which in some cases have a concentric ringed appearance of light and dark tissue, or as an irregular patchwork of bronzed tissue which either follows the veins or is spread over the leaf surface (Fig. 3). In some instances bronzing is diffuse with no delimitation of particular areas. As a rule the markings are more pronounced on the basal leaflets of the compound leaves and on the basal portions of the individual leaflets (Fig. 3). At first bronzing is more apparent on the upper leaf surfaces, but as the disease develops it becomes marked also on the undersides. Still later the affected areas die, causing the leaves to become brown and withered. Markings also make their appearance on the stems and leaf petioles, where they occur as isolated patches or streaks. After a few weeks the diseased plants appear markedly stunted in contrast to healthy plants (Fig. 4).

Infection occurs at all stages of growth, but the older the plants are at the time of infection the less marked are the symptoms. In very young plants bronzing is often followed by shrivelling of leaves and death of the plants. Older plants usually remain alive in a stunted condition for several months. Under certain conditions such plants produce weak shoots, which appear to be healthy, although at times

FIG. 1. TOMATO-PLANT NATURALLY INFECTED WITH SPOTTED-WILT.

An early stage of the disease, showing the bunched appearance of the growing points.

[*Photo by H. Drake.*

FIG. 2. SPOTTED-WILT SYMPTOMS ON ARTIFICIALLY INOCULATED TOMATO-PLANT.

On left uninoculated plant of same age.

[*Photo by H. Drake.*

the foliage shows mottling similar to that present on mosaic-infected plants. Eventually bronzing appears, and growth again ceases. On plants which are nearing maturity at the time of infection leaf symptoms are slight or entirely absent. The fruit on such plants usually develops normally, but occasionally in the early part of the season bronzing and distortion of the fruit occurs. The fruit may even ripen without showing symptoms, but usually the presence of the

FIG. 3. BRONZE MARKINGS ON LEAF FROM A TOMATO-PLANT NATURALLY INFECTED WITH SPOTTED-WILT.

[*Photo by H. Drake.*

disease becomes evident by the appearance of light-red, yellow, or almost white patches, which contrast with the bright red of the ripe fruit. The discoloured patches may occur as isolated circular areas, as concentric circles, or as confluent patches covering a considerable surface of the fruit (Fig. 5). Discoloration usually penetrates some distance below the surface, but does not appear to affect the quality or flavour of the fruit. On account of its mottled appearance, however, such fruit is not marketable.

Economic Importance.

Plants infected in the early stages of growth either die or remain very stunted, and thus produce no fruit. Those infected at a later stage may develop fruit which is in some instances marketable, but usually is rendered unsaleable by discoloured areas.

Losses, which are practically confined to the field crops, are greatest in the Hutt Valley. Under the conditions existing there little infection occurs early in the season, and it is only in the mid-season and late crops that a high percentage of the plants become infected. Fifty-per-cent. infection has been observed in mid-season crops, and in some instances growers claim that their late crops have produced no

FIG. 4. STUNTING OF TOMATO-PLANTS CAUSED BY SPOTTED-WILT.
[*Photo by H. Drake.*

marketable fruit. Losses are greater in some years than in others, and the percentage infection varies from one crop to the next. Surveys made during the 1933–34 and 1934–35 seasons of numerous tomato gardens throughout the Hutt Valley failed to disclose a single crop free from the disease.

Identity of the Disease.

An investigation of the disease was commenced during the 1933–34 season. Since the symptoms appeared to be identical with those of spotted-wilt, experiments were carried out to determine whether, in common with spotted-wilt, it (1) was of a virus nature, (2) was able to infect tobacco, (3) produced local lesions on tobacco, and (4) was similarly short-lived in extracted juice.

(1) *Virus Nature.*—The virus nature of a disease may be proved by reproducing the symptoms on healthy plants either (i) by transference of insects which have fed on an infected plant, or (ii) by artificial inoculation with juice extracted from diseased material. In the present instance artificial inoculations alone were carried out.

EXPERIMENTAL METHOD.

Tomato-plants were raised in an insect-free glasshouse and transplanted into 6 in. pots. In most cases the plants remained in an insect-free house throughout the duration of the experiment, but in

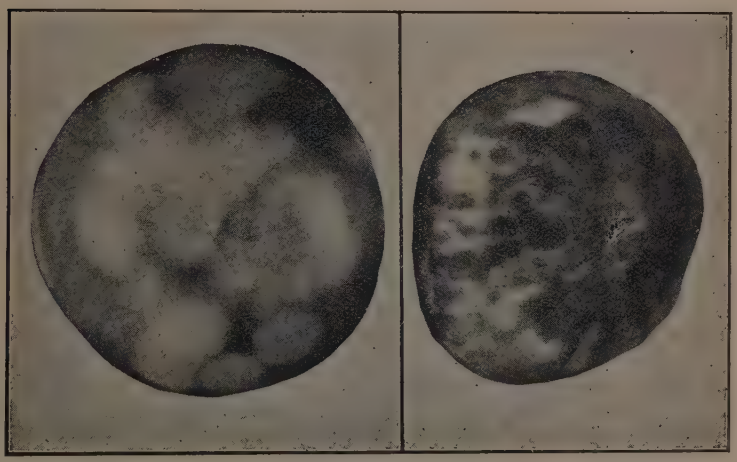

FIG. 5. MARKINGS, CAUSED BY SPOTTED-WILT, ON RIPE TOMATO FRUIT.
[*Photo by H. Drake.*

several instances they were removed from the glasshouse to harden off before they were inoculated and remained in the open until symptoms appeared.

Juice extracted by grinding in a mortar leaves taken from a recently infected plant was used as an inoculum. This inoculum, undiluted or reduced to half strength with distilled water, was applied to healthy plants within twenty minutes of extraction. Six to twelve leaflets of each plant were inoculated by the "leaf-rubbing" method evolved by Holmes (1929A), muslin moistened in the inoculum and stretched over the forefinger being used in the manner described by Bald and Samuel (1931).

RESULTS.

The results of a number of experiments in which the disease was transmitted by artificial inoculations are shown in Section A, Table I. From these it is apparent that the disease is of a virus nature.

Table I.—Transmission of the Disease by Means of Artificial Inoculations.

Experiment No.	Date of Inoculation.	Source of Inoculum.	Number of Plants.	Number of Plants infected.	Incubation Period.*
		A.—TOMATO TO TOMATO.			
1	11/12/33	Field, Lower Hutt† ..	12	4	Not observed.
		Check	12	0	..
2	23/1/34	Plant × experiment 1 ..	12	11	15 days.
		Check	6	0	..
3	23/2/34	Field, Lower Hutt ..	7	5	15 days.
		Check	7	0	..
4	11/12/34	Field, Lower Hutt ..	6	6	10 days.
		Check	6	0	..
5	19/12/34	Field, Palmerston North	5	3	Not observed.
		Check	5	0	..
6	30/12/34	Plant × experiment 4 ..	5	5	20 days.
		Check	2	0	..
7	11/1/35	Field, Lower Hutt ..	6	6	20 days.
		Check	6	0	..
8	23/2/35	Field, Lower Hutt ..	18	8	15 days.
		Check	9	0	..
9	10/3/35	Plant × experiment 8 ..	4	3	12 days.
		Check	4	0	..
		Total inoculated plants	75	51	..
		Total check plants	57	0	..
		B.—TOMATO TO TOBACCO.			
1‡	23/2/34	Field, Lower Hutt ..	4	2	19 days.
		Check	4	0	..
2‡	23/2/34	Field, Lower Hutt ..	16	7	12 days.
		Check	8	0	..
3	10/12/34	Field, Palmerston North	6	1	24 days.
		Check	6	0	..
4	11/12/34	Field, Lower Hutt ..	6	2	23 days.
		Check	6	0	..
		Total inoculated plants	32	12	..
		Total check plants	24	0	..

* It was not always possible to make daily observations of the plants, so that in some cases the incubation period may have been one or two days shorter than that recorded in the table.

† "Field, Lower Hutt," indicates that naturally infected plants collected in the field at Lower Hutt were used as source of inoculum.

‡ The source of inoculum for these two experiments was the same, but inoculated plants of experiment 1 were older than those of experiment 2.

The symptoms of the disease under glasshouse conditions are different in certain respects from those occurring in the field. Plants grown in 6 in. pots in the glasshouse are not so vigorous as those in the field, and this appears to affect the symptoms. The typical downward curling of the leaves and the "bunchy

top" appearance are not so marked. Infected plants become severely stunted and the foliage turns yellow. Characteristic leaf markings appear, but as a rule are not very extensive. By inoculating plants grown in 8 in. pots and supplied with artificial manure it was possible to produce symptoms more typical of those occurring in the field (Fig. 2).

(2) *Transmission to Tobacco.*—When inoculating tobacco the same method was used as for tomatoes, juice extract from infected tomatoes being applied to two or three leaves of each plant. The results of the cross-inoculation experiments are given in section B of Table I. It is evident from these results that the disease is readily transmitted to tobacco.

The symptoms on tobacco-plants grown in the glasshouse are as follows: Within four to eight days of inoculation isolated, roughly circular necrotic areas appear on the inoculated leaves. These, later referred to as local lesions, usually

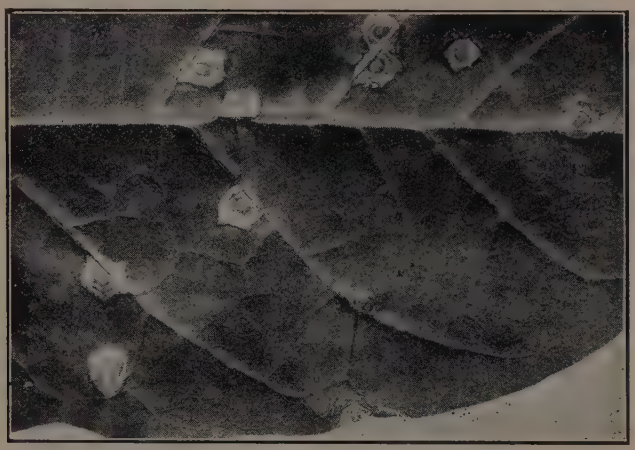

FIG. 6. LOCAL LESIONS OF SPOTTED-WILT ON TOBACCO.

Leaf artificially inoculated by rubbing with juice from an infected tomato-plant. [*Photo by H. Drake.*

have a concentric ringed appearance (Fig. 6). They are followed in from seven to fourteen days by the secondary symptoms of the disease. On small plants still in the rosette stage all the leaves wilt, and death of the plant quickly follows. On older plants a black streak appears upon one side of the stem and the top bends over (Fig. 7). The young leaves wilt and die, and dark necrotic areas, following along the veins, appear on the older leaves. All growth ceases.

(3) *Formation of Local Lesions.*—Holmes (1929B) in carrying out artificial inoculations discovered that tobacco mosaic produced on certain hosts necrotic local lesions at the points where the virus successfully penetrated the leaf tissues. Lesions of this nature are produced only by certain viruses and only on certain hosts. They are of definite types (Samuel, 1931), and may be used, therefore, as an aid in classifying viruses.

In the above-mentioned cross-inoculation experiments, in all cases where the disease was successfully transmitted to tobacco secondary symptoms were preceded by local lesions. These lesions (Fig. 6) appeared to be identical with local lesions of spotted-wilt on tobacco, as described by Samuel and Bald (1933A).

(4) *Longevity of the Virus.*—Viruses are able to grow and multiply only within living cells, but remain viable in extracted juice for varying lengths of time. The longevity in the juice is a constant character of a virus, and is therefore of diagnostic value. It has been shown by Samuel and Bald (1933B) that longevity, or rate of ageing, of a virus may be determined by the use of local lesions, and this method has been employed in the present instance.

FIG. 7. SPOTTED-WILT SYMPTOMS ON AN ARTIFICIALLY INOCULATED TOBACCO-PLANT.

Plants grown in glasshouse. On right uninoculated plant of same age.

[*Photo by H. Drake.*

EXPERIMENTAL METHOD.

The plants were inoculated by drawing firmly over the leaf surface a glass spatula moistened with the extracted juice, according to the method outlined by Samuel and Bald (1933B). To obtain direct comparisons one-half of a leaf was inoculated with juice extract of one age and the other half with juice extract of a different age. Four half-leaves on each plant were inoculated.

The results are given in the following table :—

Table II.—Longevity of the Virus in Extracted Juice.

Age of Juice Extract.	0–15 Minutes.	30–45 Minutes.	90–105 Minutes.	150–165 Minutes.
Number of local lesions* ..	165	16	0	0

* Each figure represents the total number of lesions which developed on twenty half-leaves.

The results are very similar to those obtained by Samuel and Bald (1933B) for spotted-wilt on tobacco, and from them it is apparent that the virus causing the disease lives for a short time only when removed from the living tissues.

A consideration of the above experiments shows that, in all the characters tested, the New Zealand disease is similar to tomato spotted-wilt of Australia.

Summary.

(1) A serious disease of tomatoes has been present for a number of years in the Hutt Valley, and recently has appeared in the Manawatu district.

(2) A description of the symptoms of the disease is given.

(3) The disease, which may cause a total loss of infected plants, has occurred to the extent of 100 per cent. in some of the late-season tomato crops grown in the Hutt Valley.

(4) The symptoms, virus nature, transmissibility between tomato and tobacco, formation of local lesions on tobacco, and the short life of the virus in the extracted juice all indicate that the disease is identical with the Australian form of tomato spotted-wilt.

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The Fields Instructor, Christchurch, reports that a good response to basic slag has occurred on both limed and unlimed plots at Robinson's Bay, Banks Peninsula.

WINTON EXPERIMENTAL AND DEMONSTRATION FARM.

RECORD OF WORK FOR SEASON 1934–35.

A. STUART, Instructor in Agriculture.

THE season under review was not altogether a favourable one in that a fairly dry summer followed a wet spring, and although good rains fell in January and again in April pasture-growth for the season was below normal, and supplementary fodder crops, while yielding well, were not as succulent or nutritive, being affected by the unusual growing-conditions experienced.

In pursuance of the committee's policy of diversifying the farming operations the dairy herd was reduced, thirteen cows being disposed of. Unfortunately these cows were not strictly culls, but were empty cows, and in any case could not have been retained. For the season some 6,959 lb. of butterfat were actally sold from the thirty-six cows milked, compared with 10,682 lb. from forty-five cows the previous season.

A flock of one hundred breeding-ewes was purchased early in the season, together with some sixty hoggets. One hundred and forty-four fat lambs were disposed of at the end of the season, this total including a line of twenty-seven bought as store lambs. The hoggets were disposed of at a profit, and in the autumn the ewe-flock was culled, being again replaced later in the season.

Fifty-one head of cattle and eighty-nine sheep, comprised as follows thirty-five cows and heifers, twelve yearlings, one bull, three horses, two rams, and eighty-seven ewes, were wintered on the farm of 96 acres. A line of sixty hoggets was purchased early in the spring, and the committee sold the "tops" of 5 acres of swedes in May and ½ acre of swedes were sold in August for feeding-off. Each season approximately 20 acres is under the plough, and this season was no exception, about 5 acres of each of the following crops being grown: Chou moellier, turnips and swedes, and a similar area was sown down with oats and grass.

CARRYING-CAPACITY TRIAL.

This trial was laid down last season in field 6 to determine the relative carrying-capacity and production of certified versus uncertified rye-grass.

One-half (6A) was sown with certified rye-grass, and the other (6B) with a blend of five uncertified lines of rye-grass. An uncertified white-clover strain was included in both, which were sown with oats as a nurse crop.

Although the first autumn grazing resulted in favour of the uncertified blend, this was counterbalanced early in the spring by the certified line, and at the finish of the season the certified rye-grass had established a lead of 73·8 cow-days per acre and 71·75 lb. of butterfat per acre.

GRASS AND CLOVER STRAIN TRIALS.

At each end of field 9 grass and clover demonstration plots were laid down in November. These represent some thirty-six different seed mixtures, and a fairly comprehensive manurial trial is also included. It is intended to hay one trial every year, while the other will be intermittently grazed. In this way the effects of management on pastures may be demonstrated. The remainder of the field was sown

with oats as a nurse crop, the mixture employed being 30 lb. permanent-pasture rye-grass, 10 lb. uncertified rye-grass, and 2 lb. permanent-pasture white clover.

The two hundred rye-grass plots in field 7 still afford great interest to visitors. Mr. Saxby, who inspected this field in June, reported that the relative densities of the types were as follows: Type 1, 100; type 3, 85; type 4, 44; type 5, 18; type 6, 16.

The main point of interest is the consistently lower density of type 3 plots over the past four years. This density appears to be improving slightly, due no doubt to the small percentage of good plants in type 3, which are now spreading. This is most noticeable in lines which have been border-line cases between types 1 and 3.

Club-root Investigations.

The club-root trials were confined to fields 1 and 2, which last season were in swedes. The soil was heavily infected with club-root, and it was found to be practically impossible to grow swedes as a second crop, although turnips were a possibility. The yield, however, was low in comparison with first-furrow land, and the percentage of club-root high.

Two lines of New-Zealand-grown Bruce turnip-seed were tried out against a commercial line with Aberdeen Purple Top as a control. This seed was sown by hand on land preridged and fertilized with 2 cwt. per acre of superphosphate through the front box plus 2 cwt. superphosphate and carbonate of lime mixed through the rear box.

Results were as follows:—

Variety.	Yield (Tons per Acre).	Percentage Club-root on Surviving Plants.
Bruce, Line A	13·8	31·2
Bruce, Line B	19·6	19·0
Bruce, Commercial	19·0	19·0
Aberdeen Purple Top	11·9	32·9

Bruce, Line B and Commercial respectively were significantly better in yield than the remainder.

The swede experiment containing selections and strains of Wilhelmsburger Otofte and Herning with the Majestic swede as a control was a complete failure due to club-root.

In another block in which nine lines were tested on behalf of merchants the swedes were again a failure, the best yielding 8·4 tons per acre. Two turnip varieties included in this block yielded as follows:—

	Yield (Tons per Acre).	Percentage of Club-root.
Wallace	16·6	19
Purple Top Yellow	17·7	23½

In this field acre blocks of the following turnips were also grown: Victor Achilles, Wallace, Irvine's Disease-resisting, with the following results:—

	Yield (Tons per Acre).	Percentage of Club-root.
Victor Achilles	26	26
Wallace	18	41
Irvine's Disease-resisting	16	55

A block of Edina swedes was also a failure due to club-root. Nitrate of soda at the rate of 1 cwt. per acre was applied as a top-dressing in February. This encouraged a little more leafage, but the swedes were too badly attacked to recover.

A further block was devoted to a ridged rape trial, one box of the ridger sowing Broad Leaf Essex and the other a special line of rape selected by the Mycologist for resistance to club-root. Counts on the roots were taken in January, and it was found that 61 per cent. of Broad Leaf Essex was infected, and 55 per cent. of the special rape. This was extremely disappointing when it is remembered that this line had for three years stood up remarkably well in the North Island to infection. It would appear that there are strains within club-root, and therefore that each district will need to work independently in the search for club-root resistance.

However, this rape, although infected, appeared to be able to develop new roots, and did not succumb to the attack as did the bulk of the Broad Leaf Essex. In fact, after feeding off, growth continued into the winter, so much so that the Field Mycologist made arrangements for some selected roots of this crop to be transplanted and seeded this season.

The Mai turnip was also tried out on this area, and it was found to be extremely resistant to club-root. The yield was approximately 15 tons per acre, which was doubled when sown in first-year ground with the same manuring. This soft turnip is of definite value to the dairy-farmer wishing to secure early autumn feed on land subject to club-root, but it is understood that the seed is practically unprocurable at the present time.

Miscellaneous Experiments.

In field 5, which was ploughed early in the winter, three varieties of swedes were grown—Tipperary, Success, and Webb's Masterpiece. One-half of the area was prelimed with 10 cwt. of carbonate of lime, and when ridged the manurial treatment consisted of 2 cwt. per acre of superphosphate applied through the front box plus 2 cwt. of a mixture of equal parts of superphosphate and carbonate of lime through the rear box.

Although no differences could be detected with the eye, on weighing the limed area the average yield was 40·7 tons per acre, compared to 34·3 tons on the unlimed. On the limed area the varieties yielded as follows :—

Variety.	Yield (Tons per Acre).
Success	44
Tipperary	43
Webb's Masterpiece	35

It would thus appear to be sound policy to lime immediately after breaking up ground, instead of the more usual practice in this district of liming when sowing down to grass.

A small oat-variety trial was hand-sown, and comprised the following varieties : Algerian (six selections), Ruakura, Garton's Abundance, and Lampton. Two blocks were autumn-sown, and one sown in the spring. The trial was handicapped, as some neighbouring lambs gained access and grazed the oats as late as November, and damage by birds precluded any observations as to grain-yield.

An experiment of great interest to grass-seed producers was laid down at the end of November. Three hundred lines of different rye-grass strains and twenty lines of timothy were included. These lines will be harvested separately this summer, with the idea of selecting lines

of high germination. The success of this experiment really depends on a heavy December rainfall, as it is this factor that is associated with the low germination of certified rye-grass seed grown in Southland in normal seasons.

A trial with Agrosan-treated oats was also carried out, but no differences could be detected compared with the block treated with formalin, both lines being free of smut.

A small hand-sown swede and turnip variety trial, including Elephant, Superlative, White Flesh Purple Top and Hernings swede, Imperial Green Globe, Green Top and Purple Top Aberdeen, Purple Top Mammoth, Devonshire Greystone, Lincoln Red Globe, and Mai turnip, was laid down in field 5, mainly in order to secure show material.

In field 13 the rate of liming trial on grass laid down in August, 1933, was kept under observation, and this year a lime difference due to increased cover was noticed on the block receiving the 4-ton application of carbonate.

ACKNOWLEDGMENTS.

The farm-manager, Mr. P. McMillan, deserves to be complimented on the volume of work performed in such a capable manner.

During the season under review the farm committee has been under the able chairmanship of Mr. D. H. McLean, Caroline.

Material assistance has again been forthcoming from the R. M. McKinnon Trust, in addition to the Government subsidy, which is greatly appreciated by the committee.

The following firms donated swede and turnip seed: Messrs. F. Cooper, Ltd., Wellington; Messrs. Wright, Stephenson, and Co., Invercargill; and Messrs. J. and J. S. Price, Invercargill.

GOVERNMENT OFFICIAL HERD-TESTING OF PUREBRED DAIRY COWS.

SUMMARY OF THE 1934–35 SEASON'S WORK.

W. M. SINGLETON, Director of the Dairy Division, Wellington.

THE present summary, which is for the year ending 30th September, 1935, covers the eighth year of operation of the Government Official Herd-test. During this period 14,791 cows have been tested under this system, with an average of 1,849 cows per year since the commencement. It should be noted, however, that many of the cows included in this total have been under test for more than one lactation period. During the season under review 2,058 cows were tested, a falling-off of 127 cows from the 1933–34 total of 2,185. The present total is the third highest since its inception, the highest being 2,236 cows for the 1930–31 season. Again it is pleasing to record another increase in the number of herds, the figure for 1934–35 being 195, as against 184 for the preceding season, an increase of eleven herds. This is the highest number of herds yet tested during any one season under the Government Official Herd-test, and no doubt can be interpreted to signify an advancing popularity of the system with breeders using the Certificate-of-Record testing. The highest number of Certificate-of-Record breeders during the same period was 228, and therefore all but thirty-three breeders availed themselves of the opportunity to test other animals of their herd by means of the Government Official Herd-test. It is

probable that the unfavourable financial position compelled many breeders to choose the Government Official Herd-test in preference to the more expensive, although more complete, Certificate-of-Record Test, and this no doubt also contributed to the decrease in the number of Certificate-of-Record entries during the last few seasons. Signs of recovery, however, are apparent.

The average butterfat per cow has decreased by 1·86 lb., last season's average being 310·04, as compared with 311·90 lb. for the previous year, but a point worthy of note is that despite the unfavourable season the average milking period increased by five days, the figure for 1934–35 being 285 days, as against 280 for last season. The figures quoted, together with those in the accompanying tables, are on the basis of all cows on test for six months (180 days) or more, which has proved to be the most satisfactory classification, the Government Official Herd-test being a ten-months test. Cows other than registered purebreds are omitted from the tables, although a small number are tested each year by special arrangement. Last year the number of cows tested under this heading was thirty-one, as compared with thirty-two for the preceding season. The number of registered purebred cows which are not included in the summary tables total 151, these not being on test 180 days or more.

The following average butterfat figures for the different systems of testing in New Zealand may be of interest for comparison: New Zealand's average herd-test cow for the same season, including all cows in milk 100 days or more, yielded 252·01 lb. butterfat in 258 days. The Government Official Herd-test average on the same basis was 303·75 lb. in 280 days, while the Certificate-of-Record 305-day test average was 426·23 lb., and the Certificate-of-Record 365-day test, 527·45 lb.

Table 1.—Official Herd-testing in Two Past Seasons on Basis of all Cows on Test for 180 Days or more.

Breed.	Number of Breeders.	Number of Cows.	Average Yield for Season.		
			Days.	Milk.	Butterfat.
		Season 1933–34.		lb.	lb.
Jersey	152	1,393	282	5,998·0	324·72
Friesian	18	399	281	8,070·6	283·53
Milking Shorthorn	7	142	275	7,341·4	294·93
Ayrshire	2	25	253	6,430·3	265·14
Red Poll	2	25	251	5,227·9	209·19
Guernsey	1	5	275	6,113·9	310·25
Shorthorn	1	6	301	6,367·4	248·17
Totals and averages	179*	1,995	280	6,565·3	311·90
		Season 1934–35.			
Jersey	151	1,368	287	5,955·7	320·85
Friesian	20	285	284	8,271·6	295·19
Milking Shorthorn	7	182	276	6,332·9	264·69
Ayrshire	2	31	292	6,708·2	266·06
Red Poll	1	4	234	3,324·3	134·44
Guernsey	1	6	300	5,079·6	271·26
Shorthorn	Not represented.				
Totals and averages	178*	1,876	285	6,348·2	310·04

* Totals do not agree for the reason that some breeders tested more than one breed.

Table 2.—Average Production in Classes and Breeds for all O.H.T. Cows.

Class.		Season 1933–34.				Season 1934–35.			
		Number of Cows.	Average Days.	Average Milk.	Average Butterfat.	Number of Cows.	Average Days.	Average Milk.	Average Butterfat.
				lb.	lb.			lb.	lb.
Jersey	Two-year-old and under	561	283	5,383·4	292·85	582	286	5,252·4	282·42
	Three-year-old	258	286	6,196·0	339·64	218	287	6,139·9	341·51
	Four-year-old	210	279	6,358·0	344·65	199	286	6,465·8	346·45
	Mature	364	280	6,597·1	351·77	369	289	6,681·3	355·45
Friesian	Two-year-old and under	155	282	6,619·6	230·47	86	284	7,274·5	256·84
	Three-year-old	55	279	7,975·8	285·48	46	278	7,865·8	279·55
	Four-year-old	75	281	9,009·0	314·24	47	275	7,841·1	283·67
	Mature	114	282	9,471·6	334·54	106	289	9,447·5	338·24
Milking Shorthorn	Two-year-old and under	40	272	6,183·5	251·12	45	275	5,159·4	211·09
	Three-year-old	22	273	6,736·3	275·68	33	274	5,672·6	252·92
	Four-year-old	24	268	7,054·1	285·24	33	269	5,874·3	270·00
	Mature	56	281	8,529·3	337·92	71	281	7,597·2	301·63
Ayrshire	Two-year-old and under	16	253	6,008·7	252·31	6	291	5,099·7	209·79
	Three-year-old	6	240	6,595·7	263·50	2	287	5,844·2	245·40
	Four-year-old	1	222	6,310·2	279·15	4	303	7,338·4	292·02
	Mature	2	305	8,727·0	365·63	19	290	7,174·8	280·54
Red Poll	Two-year-old and under	14	239	4,535·2	180·54	4	234	3,324·3	134·44
	Three-year-old	5	274	5,830·8	235·60	..	..	..	..
	Four-year-old	4	253	5,626·7	220·09	..	..	..	..
	Mature	2	280	7,772·4	321·86	..	..	..	..
Guernsey	Two-year-old and under	..	..	..	..	2	305	4,739·8	252·77
	Three-year-old	1	216	4,141·9	216·00	..	..	..	..
	Four-year-old	2	305	6,366·2	327·21	..	..	..	..
	Mature	2	276	6,847·6	340·43	4	298	5,249·6	280·51
Shorthorn	Two-year-old and under	3	298	5,429·6	299·32	Not represented.			
	Three-year-old	1	305	6,010·2	264·95				
	Four-year-old	..	..	..	..				
	Mature	2	305	7,952·8	298·07				

THE USE OF INSECTICIDES IN THE CONTROL OF THE WHITE BUTTERFLY.

PROGRESS REPORT.

W. COTTIER, Entomology Section, Plant Research Station, Palmerston North.

ALTHOUGH it is anticipated that the imported parasites will keep down the numbers of the white butterfly to a sufficiently low level on cruciferous crops generally, it is considered probable that some additional chemical control may be necessary in such areas as market and private gardens, where often 100 per cent. control is necessary.

At the Plant Research Station last season an extensive series of very closely examined trials were carried out on white-butterfly control on cabbages, and it is the purpose of this article to discuss these results for the benefit of growers generally.

EXPERIMENTAL METHOD.

Cabbages were used for this work. Each row contained thirty plants spaced at a distance of 2 ft., and each row was 1 yd. apart. Each treated plot consisted of two adjoining rows containing altogether sixty cabbages. The row immediately on each side of each plot was left untreated to act as a control. The arrangement was thus: One untreated row; treated plot of two rows; one untreated row; treated plot of two rows; one untreated row, and so on, in this manner throughout the experiment. Thus each plot was provided with controls immediately adjacent, so that any variation in infestation over the blocks could be taken into consideration when determining results.

The sprays were applied with an ordinary knapsack spray-pump, and the dusts with the small hand duster shown in Fig. 2. The dusts, with a few exceptions, were applied at the same rate by volume, but the weights varied a great deal, the same volume of proprietary derris dusts varying from 11 lb. to 28 lb., according to the carrier used. The exceptions were some of the lead arsenate, calcium arsenate, and barium fluosilicate dusts, which in the particular tests concerned were applied at such rates that the same weight of arsenate or fluosilicate was applied per plot as was used in certain of the sprays.

The insecticides were applied in early January, early February, and the middle of February, and on one block a fourth treatment was given in the first days of March. The cabbages at times of treatment were large and well grown. Spraying was carried out during the day, but all dusting was made in the early morning when the dew was on the plants and the air was calm.

In late February and in March results of all treatments were secured by counting the numbers of white butterfly caterpillars on the cabbages in every row—treated and controls.

MATERIALS USED.

The insecticides used in the work were—Lead arsenate, calcium arsenate, barium fluosilicate, derris, pyrethrum, summer spraying oil, nicotine sulphate, nicotine dusts, common salt (sodium chloride).

The lead arsenate was used as a spray at the rates of 2 lb., 3lb., and 4 lb. per 100 gallons of water, there being added to each mixture ½ lb. of commercial spreading-agent or 6 lb. of soft-soap per 100 gallons. Sprays were applied at the rate of approximately 240 gallons per acre. Lead arsenate was also applied in the dry-dust form mixed with finely ground hydrated lime in the proportions of 1 part of lead arsenate to

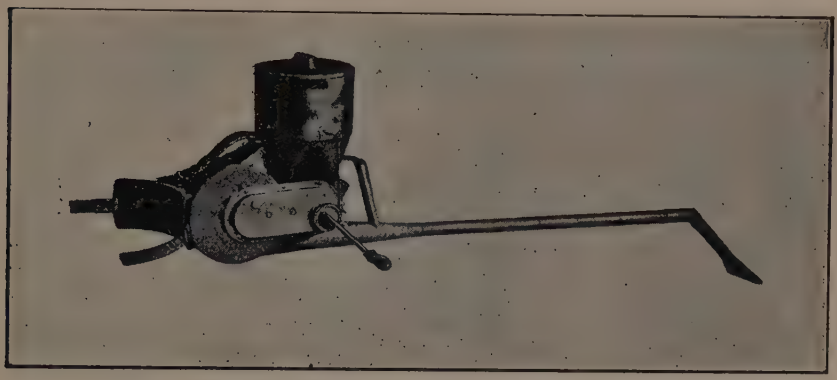

FIG. 1. HAND-OPERATED DUSTER SUITABLE FOR LARGE AREAS.

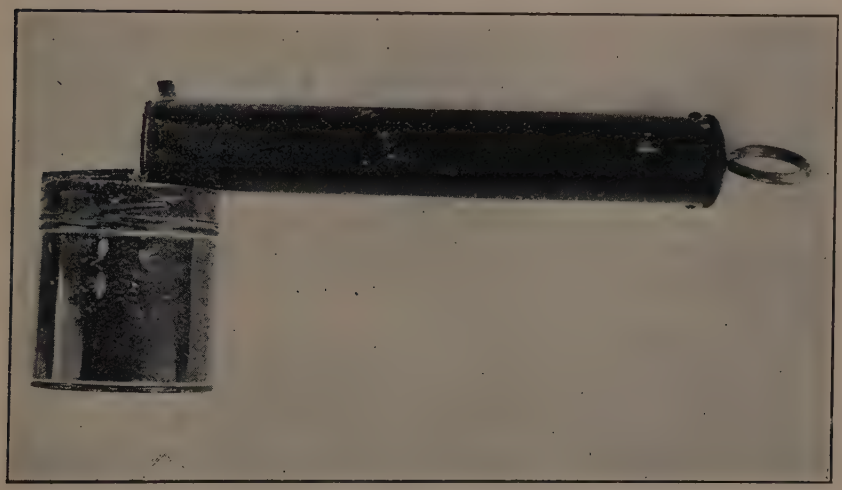

FIG. 2. SMALL HAND DUSTER SUITABLE FOR GARDEN USE.

5 parts of lime and 1 part of arsenate to 10 parts of lime. Both concentrations were used at the rate of approximately 24 lb. per acre.

Calcium arsenate, both as spray and dust, was used at the same concentrations and rates as was lead arsenate, hydrated lime again being used as a carrier for the dust.

Barium fluosilicate: The material used was a proprietary article stated to contain 80 per cent. of barium fluosilicate. Both as a spray

and dust this material was used at the same concentrations and rates as was lead arsenate, hydrated lime again being used as a carrier for the dust.

Derris dusts used were several proprietary articles containing from 0·5 per cent. to 0·75 per cent. rotenone, and, though the same volume of each dust was applied per acre, the weight per acre varied from approximately 11 lb. to approximately 28 lb. The derris sprays were also several proprietary articles, and were used according to the directions of the manufacturers, varying from 1 lb. to 20 gallons water to 1 lb. to 60 gallons water. Sprays were applied at the rate of approximately 240 gallons per acre. Derris preparations are made from plant extracts, and when used at the strengths recommended as insecticides are non-poisonous to humans.

Pyrethrum dusts were very difficult to secure, and only one proprietary dust was obtained. Pyrethrum sprays, however, were used at the rate of 1 part to 160 parts of water applied at approximately 240 to 300 gallons per acre. Alcoholic and kerosene extracts of fresh South African pyrethrum flowers were applied with an atomizer at the rate of 100 to 300 c.c. per sixty cabbages. The method of making the kerosene extract was as follows: 1 lb. of coarsely powdered pyrethrum flowers was added to 1 gallon of specially purified kerosene, kindly suppled by the Shell Co. of Wellington, New Zealand, as free as possible from aromatic, naphthenic, and unsaturated hydrocarbons. After standing twenty-four hours the mixture was filtered through cotton wool and was ready for use. A proprietary pyrethrum fly-spray was also used at the rate of 100 c.c. per sixty cabbages.

Like derris, the pyrethrum preparations are plant extracts which at concentrations sufficient to kill insects are harmless to man.

Summer spraying oil was used at concentrations of 1 part to 600 parts of water, 1 part to 100 parts of water, and 1 part to 60 parts of water. All spray mixtures were applied at the rate of approximately 240 gallons per acre. Summer spraying oil, 1 part to 100 parts of water plus a proprietary derris powder at the rate of 1 lb. to 20 gallons of spray mixture, was also used at the rate of approximately 180 to 240 gallons per acre.

Nicotine sulphate was used at concentrations of 1 part to 800, 400, and 250 parts of water at the rate of approximately 240 gallons of spray per acre.

Nicotine dusts were also used at the rate of 27 lb. per acre.

Common salt was used as a spray in water at concentrations of 3 per cent. and 4 per cent. by weight at the rate of approximately 240 gallons per acre.

For our work the calcium arsenate and derris preparations were supplied as follows: Calcium arsenate, obtained from the Fruitgrowers' Federation, Wellington, N.Z. *Derris sprays*—"Katakilla," obtained from Messrs. Cooper, McDougall, and Robertson, Ltd., Box 599, Auckland, N.Z.; "Foliafume," a mixed derris and pyrethrum spray liquid obtained from Messrs. J. A. Messenger, Ltd., 1 Anzac Avenue, Auckland, N.Z.; "Dactine," from Messrs. W. J. Craven and Co., Ltd., 48 and 50 Port Street, Evesham, England; "Dekko," from Messrs. W. J. Craven and Co., Ltd.; "Granulated Derris Extract,"

from Messrs. Stafford, Allen, and Sons, Ltd., Cowper Street, Finsbury, London, E.C. 2; "Derris Powder, with Spreader," from the Committee of Direction of Fruit Marketing, Box 771 L, G.P.O., Turbot Street, Brisbane, Queensland, Australia. *Derris Dusts*—"Deridust," from Messrs. J. A. Messenger and Co., Ltd., 1 Anzac Avenue, Auckland, N.Z.; "Derris Root Dust," from Committee of Direction of Fruit Marketing, Box 771 L, G.P.O., Turbot Street, Brisbane, Queensland, Australia; "Wee-Bee 40," from Messrs. W. J. Craven and Co., Ltd., 48 and 50 Port Street, Evesham, England; "Derris Powder," from Messrs. Stafford, Allen, and Sons, Ltd., Cowper Street, Finsbury, London, E.C. 2; "Derridust," from Messrs. W. J. Gandy, Ltd., 19 Tory Street, Wellington, C. 3, N.Z.

It is to be understood that the list of proprietary preparations shown above is merely a record of such materials used, and there is absolutely no intention of recommending them above any other such mixtures that may be on the market.

Results.

The results show that excellent control was secured with all concentrations of lead-arsenate and calcium-arsenate sprays. The lead and calcium arsenate dusts with lime were inferior to the sprays, even when the same amount of arsenate was applied in both dust and spray. The derris dusts and sprays gave excellent control, for all practical purposes being as good as the arsenate sprays, and certainly better than the arsenate plus lime dusts. The barium-fluosilicate sprays gave inferior results and burned the cabbage foliage, while the barium-fluosilicate dusts gave poor results. Nicotine-sulphate spray, even at a concentration of 1 part in 250 parts of water, gave extremely poor results, as also did the dusts. The pyrethrum dusts also were of no use. A pyrethrum spray at a concentration of 1 part to 160 parts of water gave fairly good results. The proprietary house-fly spray of pyrethrum extract also gave fairly good results, while the kerosene extract of fresh South African pyrethrum flowers gave very good results. The derris plus summer-oil spray gave excellent control, whereas the oil sprays alone gave very poor control. The salt solutions gave very poor results, and the 4-per-cent. strength stunted the growth of the cabbage foliage.

The Use of Lead Arsenate and other Arsenical Sprays.

In 1903 the Royal Commission on Arsenical Poisoning in London, decided that food for human consumption must not contain more than 0·01 grain of arsenic calculated as arsenic trioxide per pound of food material. In 1926 the subject received special interest on account of the fact that apples imported from America into England were found to be above this arsenic tolerance. Because of the amount of arsenate that must be used to combat the codling moth in America, it has since been found necessary, before marketing, to wash the arsenical residues from the fruit so that the amount can be brought to within the regulation limit. In the United States the same limit applies to fresh vegetables, which, prior to the last few seasons, were extensively sprayed with lead and calcium arsenate to control chewing insects, among these being the white butterfly. During 1932 and 1933, however, so many interstate consignments of cabbages and cauliflowers were seized and confiscated by the authorities because of excessive arsenical residues that the market was threatened with demoralization. Since that

time strenuous efforts have been made to find something to replace the arsenical sprays. The result has been the large production of derris insecticides. To-day, in the United States, derris preparations are rapidly replacing arsenicals for use on market-garden crucifers and promise to accomplish this completely in a few more seasons.

In New Zealand the regulations under the Sale of Food and Drugs Act, 1908, do not allow the presence of any arsenic or lead at all on fresh cabbages and cauliflowers. Therefore, technically, any person who uses lead arsenate on cabbages or cauliflowers and offers them for sale is likely to render himself liable to a penalty under the Act, if it is suspected that his produce contains spray residues. Perhaps it may be assumed, however, that trouble would arise only if the vegetables should contain more than 0·01 grain of arsenic trioxide per pound, the limit fixed by the Royal Commission for such foodstuffs.

To determine how much arsenic is likely to remain on cabbages sprayed with lead arsenate in adequate amounts to give control, analyses of such cabbages were carried out by the Dominion Analyst last season. The cabbages to be analysed were treated in two ways. The first lot was stripped of outside leaves so that only the heart remained, whereas the second lot comprised whole cabbages with the outside leaves not removed. The results are shown in Table 1. Sprayings were carried out at three periods—viz., 10/1/35, 1/2/35, and 11/2/35.

Table 1.

No.	Treatment.	Condition.	Number of Grains of As_2O_3 per Pound of Cabbage.	Length of Time between Last Spraying and Harvesting.
Lot 1.—No. 1 No. 2 No. 3 No. 4	Lead arsenate 2–100 plus spreader ½–100	Heart only ..	0·0005 0·0003 0·0002 0·0003	5 weeks.
Lot 2.—No. 1 No. 2 No. 3 No. 4	Lead arsenate 3–100 plus spreader ½–100	Heart only ..	0·0001 0·0001 0·0001 0·0001	,,
Lot 3.—No. 1 No. 2 No. 3 No. 4	Lead arsenate 4–100 plus spreader ½–100	Heart only ..	0·0002 0·0002 0·0002 0·0003	,,
Lot 4.—No. 1 No. 2 No. 3 No. 4	Lead arsenate 2–100 plus spreader ½–100	Whole cabbage	0·026 0·024 0·013 0·036	6 weeks 3 days.
Lot 5.—No. 1 No. 2 No. 3 No. 4	Lead arsenate 3–100 plus spreader ½–100	Whole cabbage	0·045 0·050 0·068 0·058	Ditto.
Lot 6.—No. 1 No. 2 No. 3 No. 4	Lead arsenate 4–100 plus spreader ½–100	Whole cabbage	0·118 0·231 0·188 0·220	,,

From the table it will be seen that hearts only were well below the arsenic tolerance of 0·01 grain per pound if an interval of five weeks elapsed between the last spraying and the time of harvesting. However, figures for the whole cabbages, without outside leaves removed, show that the arsenic tolerance of 0·01 grain per pound was quite easily exceeded even after a period of six weeks had elapsed between the last spraying and the time of harvesting.

The lead residue also should be considered, since it is well known that this metal has a cumulative action and is not voided from the system as is arsenic. Very small doses accumulate until they have a pathological effect, even after a period of years.

Discussion.

From the foregoing it is very evident that there is great need for a non-poisonous spray to replace the arsenicals for application to vegetables. It does not seem that there can be any satisfactory guarantee to the public that only the hearts of such vegetables, especially cabbages, will be offered for sale, and, further, that a sufficient time will elapse between the last treatment and the time of harvesting. It would not be in the best interests of the market-garden industry to run the risk of having vegetables looked on with suspicion by the health authorities and the public.

If the arsenates are ruled out as unsuitable insecticides for crops to be marketed, the situation might seem more or less desperate. However, this is not the case, because it has been demonstrated in our work that derris dusts and sprays are highly efficient in giving protection against the white butterfly. The control given was adequate and comparable with that given by lead-arsenate sprays, and this is also the conclusion that has been reached in work against this pest in other parts of the world. Besides being comparable with lead arsenate in killing-power, derris preparations have the great advantage that they can be used right up to the time of harvesting without any fear of poisoning to warm-blooded creatures, including man and the domestic animals. Derris preparations are usually somewhat more expensive than lead arsenate, but it is considered that prices are well within the limit of cost allowable in producing vegetables, and it is hoped that such non-poisonous insecticides will eventually be used to the exclusion of arsenicals.

Work in other countries shows that derris dusts are more effective generally than are sprays, and in our one season's experience in New Zealand the dusts were slightly superior to the sprays. Several treatments may be required at intervals of two or three weeks according to the severity of infestation. Growers wishing to use derris should make sure that the dust has a guaranteed rotenone content of 0·5 per cent. to 0·75 per cent. and it should be applied at the rate of 20 lb. to 25 lb. per acre, according to the manufacturers' instructions. (Rotenone is one of the active principles of derris insecticides, and the potency of the insecticide is commonly expressed on the basis of the proportion of rotenone it contains.) Fig. 1 shows a hand-operated dust-gun suitable for fairly large areas. If, however, the grower has spraying-apparatus only and prefers not to change, then he will be able to secure spray powders suitable for his purpose.

This experimental work will be continued next season and results published when available.

AGRICULTURAL LEGISLATION OF 1935.

A. E. MORRISON, Solicitor, Department of Agriculture, Wellington.

THE following notes are made on the provisions of several Acts of agricultural interest which were passed during the 1935 session of Parliament.

AGRICULTURAL REGULATIONS CONFIRMATION ACT, 1935.

By this Act the following regulations made under the Agriculture (Emergency Powers) Act, 1934, were confirmed and validated—viz., the Dairy Factories (Licensing) Regulations, 1935, and regulations authorizing dairy companies to borrow moneys out of funds provided under section 26 of the Agriculture (Emergency Powers) Act, and to lend such moneys to their suppliers of milk or cream.

PRODUCTS EXPORT AMENDMENT ACT, 1935.

This statute extends the definition of the term "products" for the purposes of the Products Export Act, 1908, to include timber, in order that the export of certain species of beech timber may be regulated and controlled in accordance with regulations to be made under the principal Act.

RABBIT NUISANCE AMENDMENT ACT, 1935.

This Act authorizes Rabbit Boards to deal in poisons or ammunition for the purpose of the destruction of rabbits in their districts or for the prevention of the incursion of rabbits therein, and for that purpose licenses may be granted under the Poisons Act, 1934, to sell poison, or under the Arms Act, 1920, to sell ammunition. The power of Rabbit Boards to sell poison in pursuance of a license granted under the Poisons Act is limited to poisons for the time being included in the Third Schedule to that Act. All purchases, sales, or other dispositions of poison or ammunition made by Rabbit Boards for the destruction of rabbits before the 11th day of October, 1935, are validated.

TOBACCO-GROWING INDUSTRY ACT, 1935.

By this Act a Board called the Tobacco Board is established. The Board shall consist of nine persons to be appointed by the Governor-General on the recommendation of the Minister of Industries and Commerce, one member being appointed as the Government representative, four members as growers' representatives, and a like number as manufacturers' representatives. The Government representative shall be the Chairman of the Board.

No tobacco shall be grown in New Zealand except in pursuance of a license granted by the Board and in accordance with such conditions to be attached to the license as are prescribed. Conditions so prescribed and attached to a license may relate to the quantity of tobacco that may be grown, the land on which it is to be grown, and the area to be used for growing the tobacco under the license. No license is required in respect of the growing of any tobacco by any person on his own land so long as no tobacco so grown is manufactured or intended to be manufactured except by the grower for his own use and that of

the members of his family residing with him, and not for sale to any other person, and so long as the tobacco so grown is not sold or intended to be sold to any other person. Every license granted for the growing of tobacco shall remain in force until the 31st July following the date stated in the license as the day on which it takes effect. The Board has a discretionary power to refuse to grant licenses for the growing of tobacco on such grounds as it shall deem sufficient. Where, however, a grower satisfies the Board that he has entered into a *bona fide* contract or arrangement with any person for the growing before the 31st July in any year of tobacco for sale to that person, the grower shall be entitled to the grant of a license for the growing of that tobacco before the date mentioned, and of a warrant authorizing him to sell the tobacco.

No raw tobacco grown or intended to be grown in New Zealand shall be sold or purchased by or on behalf of any person, and no raw tobacco grown in New Zealand shall be manufactured by or on behalf of any person who has not purchased it, except in accordance with a warrant granted by the Board authorizing such sale, purchase, or manufacture, and subject to such conditions to be attached to the warrant as may be prescribed. No warrant is required in respect of the manufacture by any person of any tobacco grown by him or on his own land for the use of himself and the members of his family residing with him and not for sale to any other person. Every warrant granted under the Act shall, unless previously revoked, continue in force for such period as may be prescribed. The discretionary powers of the Board to refuse to grant licenses for the growing of tobacco apply, *mutatis mutandis*, to the grant of warrants under the Act. Where, however, a *bona fide* manufacturer satisfies the Board that he has entered into a *bona fide* contract or arrangement with a grower for the growing of tobacco for sale to the manufacturer, the latter shall be entitled to the grant of a warrant authorizing him to purchase that tobacco. Any person shall also be entitled to the grant of a warrant authorizing him to purchase any tobacco if the Board is satisfied that the tobacco is to be exported.

The Board may require information to be supplied to it by manufacturers, growers, and other persons in relation to the tobacco industry in New Zealand. The manufacturer may be required to supply information in respect of the quantity of raw tobacco grown in New Zealand and used by him for the purposes of his business in any period, or owned or held by or on his behalf for the purposes of his business at any time; an estimate of the quantity of such tobacco that he will use for the purpose of his business in any period, with particulars of the sources from which he proposes to obtain that tobacco; and the names and addresses of all persons who have contracted to supply him with raw tobacco grown or to be grown in New Zealand, with particulars of each contract and the quantity of tobacco to be supplied by each person. The grower may be required to supply information in respect of the quantity of tobacco grown or to be grown in any period; of raw tobacco grown or to be grown and sold in any period or held by the grower and unsold at any time; the price at which any raw tobacco grown or to be grown has been sold; the area of land on which tobacco has been or is to be grown in any period or is being grown at any time; and the names and addresses of all persons to whom the grower has contracted to supply raw tobacco, with particulars of each

contract and the quantity of tobacco to be supplied to each person. The Board may also, with the approval of the Minister of Industries and Commerce, require any person (whether a grower or manufacturer or not) to supply such further information as may be deemed necessary for the effective administration of the Act, but not including information relating to formulæ, methods, or processes used in manufacture, costs of manufacture, or any other matter incidental to the process of manufacturing tobacco. All information furnished by manufacturers and growers shall be treated as confidential, and shall be supplied to the Chairman of the Board—*i.e.*, the Government representative. Except as otherwise directed by the Minister of Industries and Commerce, all information supplied by other persons shall be similarly treated as confidential. The Chairman may, however, lay before members of the Board returns showing the aggregate results of the information so supplied, classified in such manner as he thinks fit.

The Board may endeavour to promote the sale or disposal in New Zealand or elsewhere of raw tobacco grown or to be grown in New Zealand, and may recommend to the Government such action as the Board deems advisable in relation to the importation of raw or manufactured tobacco. For the purposes of the Act, raw tobacco means unmanufactured tobacco or the leaves and stems of the tobacco-plant before they have passed through any process of manufacture.

There shall be payable to the Board by way of levy on raw tobacco grown or to be grown in New Zealand and sold by or on behalf of the grower or manufactured by or on behalf of any manufacturer who has not purchased it, such charges—not exceeding a levy of ½d. per pound—as may from time to time be fixed by the Board. The Board may fix differential charges in respect of different classes of tobacco, and for that purpose may divide tobacco into such classes as it thinks fit. Charges may be fixed in respect of specified classes of tobacco without fixing any charges in respect of other tobacco. Fees at rates to be prescribed shall also be payable in respect of applications for licenses and warrants, and in respect of licenses and warrants granted under the Act.

Every person who obstructs or impedes or attempts to obstruct or impede the Board or its servants or agents in the exercise of any power, function, or duty conferred on the Board, or who fails to comply with any condition attached to a license or warrant granted under the Act or with any requirement of the Board or any provision of the Act or any regulations made thereunder, shall be liable on conviction to a fine of £100, and, in the case of a continuing offence, to a further fine of £10 for every day during which the offence continues. On conviction, the Court may revoke any license or warrant granted to the offender and then in force.

The Executive Commission of Agriculture has the same powers with respect to the Tobacco Board as it possesses with respect to other Boards established to regulate and control primary products.

Nothing in the Act shall be construed to restrict the operation of the Tobacco Act, 1908.

General.

In addition to the foregoing, reference is made to the provisions of a local Act entitled the Auckland Metropolitan Milk Amendment Act, 1935, and to certain provisions of the Finance Acts, 1935. The Auckland Metropolitan Milk Amendment Act removes certain defects found to exist in the principal Act, and generally provides better or additional

powers to regulate and control the supply and distribution of milk within the Auckland Metropolitan Milk District, which has been extended to include the Auckland Domain and Hospital Reserve, the ports of Auckland and Manukau, and any ship or vessel while in either of these ports.

Section 20 of the Finance Act, 1935, provides for the payment to local authorities from the Main Highways Revenue Fund of a subsidy equal to 12½ per cent. of the rates levied for the year ending 31st March, 1936, on lands used exclusively or principally for agricultural, horticultural, or pastoral purposes, such subsidy to be applied in relief of ratepayers by way of refund or rebate of a like percentage of the rates levied on such lands for the current financial year.

By section 37 of the Finance Act (No. 2), 1935, the New Zealand Meat-producers' Board, the New Zealand Dairy Board, the New Zealand Fruit-export Control Board, the New Zealand Honey Control Board, the New Zealand Poultry Board, and the Tobacco Board may out of their funds subsidize any fund or scheme established with the approval of the Governor-General in Council for the purpose of providing superannuation or retiring-allowances for their staffs.

THE DAIRY FACTORY MANAGERS REGULATIONS, 1934, AMENDMENT NO. 2.

THE main purpose of the above-entitled regulations, which came into force on the 5th December, is to prescribe in detail the qualifications of persons competent to be employed as managers of butter and/or cheese factories for the purpose of determining their eligibility for registration under the regulations governing the registration of dairy factory managers.

An applicant for registration after the coming into force of the amending regulations must—(*a*) Have passed the sixth standard in the primary schools or have attained a standard of education equivalent thereto; (*b*) have held a cream-grader's or a milk-grader's certificate; (*c*) be of good character and reputation; (*d*) satisfy the Dairy Factory Managers Registration Board that he has had practical experience in the performance of the major operations in a butter or a cheese factory; (*e*) satisfy the Registration Board that he has a reasonable general knowledge of the construction and functions of the plant, apparatus, and machinery used in the production and manufacture of dairy-produce, of dairy-factory management generally, and of the law regulating such production and manufacture. With regard to practical experience, an applicant must satisfy the Board that he has been actively engaged in the performance of manufacturing creamery butter and/or cheese in all its branches and that he has had in the course of his training and practical work immediate charge of and responsiblity for each of the major operations in a butter or a cheese factory, as the case may be, for a period of not less than three months. The major operations in a butter-factory are—(i) Control of the receiving platform; (ii) the neutralization, pasteurization, and cooling of cream; (iii) churning, with complete control over the whole or some number of churns in a butter-factory. The major operations in a cheese-factory are—(i) Control of the receiving-platform or one weighing-scale thereon; (ii) the pasteurization and cooling of milk; and (iii) the manufacture of cheese, with complete control over the whole or some number of vats from the time of setting until the cheese is placed in hoops.

The matters referred to in general terms in paragraph (*e*) above as to which the Registration Board is required to be satisfied before authorizing registration are set out in detail in new clauses 16A and 16B contained in clause 5 of the amending regulations. In addition to the foregoing, other amendments to the principal regulations designed to facilitate administration are included in the amending regulations under notice. Persons interested may obtain copies of the regulations on application to the Government Printer, Wellington, price 6d. per copy, remittance with order.

—*A. E. Morrison, Solicitor, Department of Agriculture, Wellington.*

APPLICATION OF ORCHARD-SPRAYS.

1. THE STATIONARY SPRAYING SYSTEM—(*continued*).

G. G. TAYLOR, Mycological Laboratory, Plant Research Station, Palmerston North.

B. The Pumping Station.

THE pumping-shed houses the equipment necessary for driving the spray mixture, under pressure, through the orchard pipes to the nozzles. Associated with the pumping-station are reservoirs and elevated holding-tanks for maintaining the water-supply.

THE PUMP.

During recent years manufacturers have made considerable improvement in the mechanical efficiency of the force pumps used for orchard-spraying, and to-day there is little to choose between the standard makes. Apart from mechanical efficiency, the significant factors to be considered when installing a pump are capacity—*i.e.*, volume delivery in gallons per minute—working pressure, and pressure-adjustment.

CAPACITY.

In determining the pump-capacity required the maximum volume of spray delivered by the nozzles should first be calculated by allowing for a delivery of 3 gallons per minute for each nozzle (or combination of nozzles) in use. Owing to mechanical losses in capacity at the pump due to "slip,"* worn valves, &c., and because a certain amount of overflow through the release-valve is necessary to maintain even pressure, the specified capacity† of the pump should exceed that calculated for supplying the nozzles by approximately 30 per cent.

In the manufacturers' specifications of a pump, capacity is usually quoted at a maximum working speed. Experience has shown, however, that greater efficiency is obtained by lowering this speed of working by 30 to 50 per cent. Since this causes a corresponding reduction in the volume of liquid pumped, the specified capacity of the pump should be sufficiently high to allow for reduced working speed and still leave the capacity approximately 30 per cent. greater than is required to supply the nozzles.

For example, with three men spraying, the maximum volume delivery at the nozzles will be approximately 9 gallons per minute. Allowing 30-per-cent. increase, the capacity required at the pump will be approximately 12 gallons per minute. By installing a pump with a specified capacity of 20 gallons at 100 revolutions per minute and reducing the working speed to 60 revolutions per minute, the required capacity of 12 gallons could be obtained.

* The term "slip" is applied to losses in capacity caused by valve lag, and separation of liquid and piston on the suction stroke.

† In considering pumps of American manufacture the specified capacity should be converted from American to Imperial units on the basis of 5 American gallons = 4 Imperial gallons (approximately).

PRESSURE.

The pressure developed by the pump should be sufficient to overcome frictional resistance to the flow of spray in the pipes and to provide for efficient mist production at the nozzles. In a properly designed piping-system maximum pressure-loss should not exceed 150 lb. per square inch, and with the nozzles at present used in New Zealand approximately 300 lb. pressure per square inch is required for efficient mist-production. Thus the pump should be capable of developing a maximum pressure of 450 lb. per square inch.

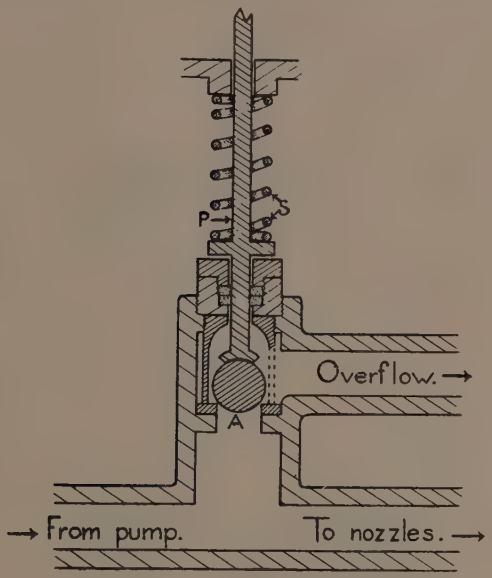

FIG. 10. RELEASE-VALVE.

Showing the ball valve A which opens when the pressure overcomes the force exerted on the stem P by the spring S.

PRESSURE-ADJUSTMENT.

For adjusting pump-pressure and allowing excess spray to be returned to the mixing-tank, either release-valves or pressure-regulators are used. In the former (Fig. 10) a spring-loaded stem acts directly on a ball valve, which lifts when the pressure is sufficient to overcome the force exerted by the spring, thus releasing pressure. In the latter (Fig. 11) a spring-loaded plunger or diaphragm lifts when the pressure is sufficient to overcome the force exerted by the spring, pressure being released through a ball valve which is unseated by means of a projecting pin attached to the plunger or diaphragm. Where release-valves are used, the pump, when in operation, is continuously working against pressure. With pressure-regulators, an additional ball valve holds the pressure in the pipe-line and beneath the plunger or diaphragm when the nozzles are closed, thus releasing pressure on the pump. Release-valves being of simple construction give little trouble in operation, and are easy to adjust. Pressure-regulators are more complicated, and thus

require greater care in adjustment to give efficient results. When properly adjusted, however, they reduce wear in the pump and lower running-costs, and for these reasons are the type usually installed.

To reduce pressure-fluctuations caused by intermittent pumping action an air-chamber is used, this being placed adjacent to the pressure-regulator and connected to the main delivery pipe. The contained air is compressed by each force stroke and expands with each suction stroke, thus helping to maintain even pressure. The volume of air in the chamber is reduced to approximately one-thirtieth of its original volume when under a pressure of 450 lb. per square inch, so that to function efficiently air-chambers should be of large size. Efficiency is further increased where provision is made for filling the air-chamber (by means of the pump) with compressed air before spraying is commenced.

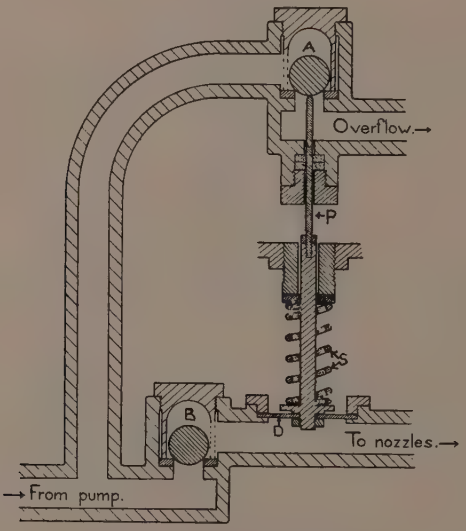

FIG. 11. PRESSURE-REGULATOR,

Showing the diaphragm D which lifts when the pressure overcomes the force exerted by the spring S and by means of the projecting pin P unseats the ball valve A. The ball valve B holds the pressure in the pipe-line and beneath the diaphragm when the nozzles are closed, thus leaving the ball valve A unseated.

A pressure-gauge is required in order to make accurate adjustment of pressure. Because of their delicate mechanism, and owing to the strain imposed by intermittent pumping action, gauges are easily rendered inaccurate. It is advisable to place the gauge either on top of the air-chamber or on a special air-chamber consisting of a length of $\frac{3}{4}$ in. pipe, since in this position it is least subject to strain.

Mixing-tanks.

Concrete or wooden mixing-tanks are used for holding the spray mixture. Either give efficient service, but concrete tanks have the advantage that they do not deteriorate. In small orchards a single mixing-tank is sufficient; in larger orchards the time lost by nozzlemen in waiting for spray mixtures to be prepared can be avoided by the use of duplicate tanks.

The size of the tanks should be such that they may be emptied in about one hour, since sprays such as nicotine deteriorate if left for longer periods, and combinations such as lead arsenate and lime sulphur become liable to cause tree injury. The approximate size may be calculated by allowing 150 gallons tank capacity—(*i.e.*, 24 cubic feet) for each nozzleman.

Mixing-tanks are invariably built square or oblong in plan, the use of cylindrical tanks having been abandoned owing to difficulties in agitation, cleaning, &c. In designing tanks the bottom should be rounded to assist agitation, sufficient slope allowed towards the suction intake from the pump for complete emptying, and a large plug-hole provided at the lowest point to facilitate cleaning. Tanks deeper than 3 ft. 6 in. are inefficient, owing to their inaccessibility and because increase in depth reduces the efficiency of agitation. In determining the dimensions required to give any particular capacity, allowance should be made for the curvature in the bottom and for a height about 6 in. in excess of the level of the spray mixture. When building concrete tanks the surface should be finished with cement plaster to prevent leakage.

The spray mixture is delivered to the pump either through a pipe built permanently into the bottom of the tank or through a flexible pipe which hangs from the lip of the tank. The latter type is preferable, being more easily cleaned and readily moved from one tank to another.

Agitators.

Agitation of the spray mixture is necessary to maintain even distribution of particulate solids and to assist in the production and maintenance of oil emulsions. The type of agitator most commonly employed consists of a horizontal shaft provided with two-bladed propellors and driven by the pump engine. Agitators with vertical shaft are rarely used, since they do not give as efficient agitation as horizontal types, being suited only to cylindrical tanks. The number of propellors required depends on the size of the mixing-tanks, two being used with a 200 gallon tank, three with a 300 gallon tank, &c. In order to maintain effective agitation until the tank is emptied, the shaft should be situated so that the propellor-blades nearly touch the bottom of the tank. This type of agitator driven at about 100 revolutions per minute gives satisfactory results with the spray mixtures at present used in New Zealand.

The Power Unit.

Petrol-engines or electric motors are used for driving the pump and agitator. Where electric power is available the motors are preferable, since they are not subject to the erratic engine-speeds of the former, are easier to operate, less expensive to purchase, and, being relatively free of mechanical troubles, are cheaper to keep in repair.

Horse-power requirements depend mainly on pump-capacity and working-pressure, but additional power is required to overcome frictional resistance in the pump and to drive the agitator. The required brake horse-power may be determined by allowing 1 b.h.p. for each 10 gallons pump-capacity at 100 lb. pressure per square inch. Thus a pump of 10 gallons capacity working at 450 lb. pressure requires a power-unit of approximately 4·5 b.h.p., and a pump of 15 gallons capacity working at 450 lb. pressure requires a power unit of approximately 6·75 b.h.p., &c.

Reliance, usually, can be placed on the specified brake horse power of electric motors, but not on the rated values of many petrol-engines. Where petrol-engines are to be used it is advisable, therefore, to install those of reputable manufacture and guaranteed performance.

Reservoirs and Holding-tanks.

Reservoirs are necessary in some districts to conserve a supply of water for periods of drought, and in most orchards elevated holding-tanks are required to provide a rapid flow of water for filling the mixing-tanks.

Concrete reservoirs built into the ground have been found most efficient for holding large quantities of water. The size required depends on the volume of water used to spray the orchard and on the maximum period over which shortage is likely to occur. Reservoirs should be as deep as possible, with a small surface area which can be boarded over, thus reducing loss of water by evaporation, which from an uncovered surface 20 ft. square may exceed 200 gallons per week. Where possible, the reservoir should be at a higher level than the pumping-station and provided with a large-diameter delivery-pipe, thus obviating the use of an additional holding-tank.

Holding-tanks may be built in concrete or made of galvanized iron. They should be situated adjacent to the pumping-station and at a higher level than the mixing-tanks, and provided with a large-diameter delivery-pipe. For filling the holding-tank a small auxiliary pump is required, with sufficient capacity to maintain the water-supply for one complete spraying-period. The size of the holding-tank should be such that the volume of water it will hold, plus the amount that can be pumped into it during the day, will be sufficient for one day's spraying.

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STREPTOCOCCI WHICH PRODUCE A SUBSTANCE INHIBITING THE GROWTH OF LACTIC STREPTOCOCCI.

OCCURRENCE AND DISTRIBUTION.

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Whitehead and Riddet(1) succeeded in isolating from certain milk-supplies an organism which was shown to be the cause of an inhibition of acid-production during the cheesemaking process. The phenomenon is colloquially known among cheesemakers as "non-acid" trouble. Since the first observation many instances of slow development of acidity in single vats of milk have been proved to be due to the presence of the same type of organism. Whitehead(2) gave an account of the biological properties of two strains of the inhibitory organisms and showed that they were lactic streptococci; one strain resembled *Str. cremoris* and the other *Str. mastiditis*, except that in both cases a peculiar inhibitory substance was formed during growth.

It was considered desirable to make some attempt to determine the habitat of inhibitory streptococci in the hope that if there were any predominating source it would prove possible to give more precise directions for the exclusion of the organisms from milk on the farm. The similarity of some strains to *Str. mastiditis* suggested that they might be found within the udder in some cases of disease. On the other hand, Mr. W. H. Udy, of the N.Z. Co-op. Dairy Co. (private communication) was able to isolate strains very readily from silage. The present paper is an account of a more detailed examination of the possible sources.

Methods used for Detection of Inhibitory Streptococci.

During the course of our investigations Cox(3) devised a simple method, depending on the use of methylene blue, for the detection of inhibitory streptococci or their products in milk-samples. This replaced the more tedious method of the "vitality test," and enabled large numbers of samples to be examined at the one time. Moreover, the detection of small numbers of inhibitory streptococci in samples of milk freshly drawn necessitated the employment of an enrichment method, since any method of rapid detection, apart from actual isolation of the organisms, depends on the production of a reasonable amount of inhibitory substance in the milk. Milk samples were therefore incubated at 30° C. until clotting took place. Three millilitres of the clotted sample were mixed with 15 millilitres of normal fresh milk and after the mixture had been pasteurized at 63° C. for fifteen minutes it was tested according to Cox's methylene-blue technique. The method has obvious limitations: if the number of inhibitory streptococci is below some undefined minimum, the organisms may fail to grow on occasions. Moreover, in some cases the streptococci may be overgrown and checked by other organisms, and thus prevented from forming a detectable amount of the inhibitory substance. The inhibitory streptococci are favoured in milk, however, since they belong to the group of lactic-acid organisms, and with a reasonable initial number in any sample one would not expect a large percentage of failures in detection.

The relative sensitivities of the "vitality test" and the methylene-blue test for inhibitory organisms were compared in the following experiment. A culture of inhibitory organisms was mixed with fresh milk in various proportions, and portions of each mixture were pasteurized at 63° C., 82° C., and 100° C. for thirty minutes. Methylene-blue tests for the presence of inhibitory substance were then carried out, as well as a vitality test on a portion of each mixture heated to 63° C.

The results (Table 1) show that although the vitality test demonstrates quite satisfactorily the presence of inhibitory organisms, the methylene-blue method gives in general a more clear-cut and outstanding result in borderline cases.

From columns IV, V, and VI it is evident that the methylene-blue inhibitory test was most sensitive when the heating was carried out at 63° C. Heating at higher temperatures evidently destroyed a certain amount of the substance produced by the inhibitory organisms. For this reason 63° C. was chosen as the best temperature for heating the tubes of milk. Another experiment showed that heating at this

Table 1.

The Milks and their Quality.				Tests for Inhibitory Organisms.				
				Methylene-blue Test.			Vitality Tests.	
No. of Sample.	I. Proportions in which Milk and Culture mixed.	II. Number of Organisms per Millilitre: Breed's Method.	III. Reductase Test on Raw Milk: Time for Discolorization.	IV. Tubes of Milk pasteurized at 63° C., ½ Hour.	V. Tubes of Milk pasteurized at 82° C., ½ Hour.	VI. Tubes of Milk heated at Boiling Temperature, ½ Hour.	VII. Milks pasteurized in Bottles at 63° C., ½ Hour: 1 per Cent. Starter added to each.	
	Parts Fresh Milk. Parts Thick Culture.							
							5½ Hour.	6½ Hour. Rise.
1	15 + 3	456,000,000	5 minutes	4¼ hours	4¼ hours	4¼ hours	1·9	2·0 0·1
2	15 + 2	324,000,000	10 minutes	4¼ hours	4¼ hours	4¼ hours	1·7	1·8 0·1
3	15 + 1	246,000,000	¼ hour	4¼ hours	4¼ hours	4¼ hours	1·5	1·8 0·3
4	15 + 0·5	91,800,000	¾ hour	4¼ hours	4¼ hours	¾ hour	1·5	2·1 0·6
5	15 + 0·1	15,600,000	3½ hours	4¼ hours	2¼ hours	¾ hour	2·5	4·8 2·3
6	15 + 0·05	7,320,000	3¾ hours	4¼ hours	1¼ hours	¾ hour	2·5	5·3 2·8
7	15 + 0·01	1,140,000	5½ hours	2¼ hours	1¼ hours	¾ hour	3·8	6·2 2·4
8	Control ..	980,000	> 5½ hours	2¼ hours	1½ hours	¾ hour	3·4	6·5 3·1

temperature for ten to fifteen minutes was as satisfactory as heating for half an hour, and the shorter time was therefore adopted in general practice.

Occurrence of Inhibitory Organisms in Mixed Milk.

It was of interest in the first place to determine how often the organisms occurred in a mixed supply of good-quality milk produced with a reasonable amount of care but with no special precautions. The milk-supply under examination (that of the Massey Agricultural College Farm) was used for the manufacture of cheese from September to May, and on no occasion during that period was any trouble due to inhibitory organisms experienced in the cheese-vat. Samples of the milk were taken daily; they were incubated at 30° C. until they clotted (two to three days), and were then tested for the presence of inhibitory substance by the methylene-blue method. Table 2 shows the number of samples examined and the number of positive results obtained in each month throughout the year.

Table 2.

Month.	Total Number of Samples tested.	Number of Samples containing Inhibitory Organisms.
April, 1934	21	1
May, 1934	25	2
June, 1934	24	0
July, 1934	26	3
August, 1934	26	0
September, 1934	25	5
October, 1934	26	5
November, 1934	26	1
December, 1934	18	5
January, 1935	23	13
February, 1935	20	7
March, 1935	26	9

It is evident that although there were never large enough numbers of inhibitory streptococci in the milk to cause any trouble in cheese-manufacture, yet on many days the organisms were present in small numbers. The results also show that the organisms tended to occur more frequently in the summer months.

Occurrence of Inhibitory Organisms in Milk from Individual Cows.

The next step was to determine whether the inhibitory streptococci present in the mixed milk-supply on certain days were derived from within the udders of some of the cows or were the result of contamination during the milking process. Samples were therefore drawn by hand from single cows, with precautions against contamination. The udder was thoroughly washed with water and then with a hypochlorite solution. Two streams of milk from each

quarter were rejected, and samples were taken in sterile bottles or tubes held almost in a horizontal position during the short time it was necessary to have the containers open. Almost all the cows from the herd (which reached a maximum of 115) were examined, some of them several times: several hundred samples of milk were tested in all. Inhibitory organisms were found from time to time in the milk of fifteen cows. Positive results were not obtained regularly with any one animal, and in the majority of cases the organisms were found only at rare intervals; but in the case of one animal seven out of thirty-two examinations (three within an eight-day period) gave a positive result. This case alone seems to exclude the possibility of the occurrence of the inhibitory organisms being due to contamination of the milk from outside sources due to a faulty technique in drawing the samples.

The results indicate, therefore, that inhibitory streptococci existed within the udder (or teat canals) of certain cows. Their relatively infrequent detection in many instances may have been due to the limits of sensitivity of the method used, since, as has already been mentioned, the numbers of organisms present in the freshly drawn milk were evidently extremely small, and the survival and growth of the few bacterial cells present must have depended to some extent on chance conditions.

An examination of the records of the cows in the herd gave no indication of any correlation between udder-disease and the occurrence of inhibitory streptococci. Of the cows suffering from mastitis, some yielded inhibitory organisms in the milk and some did not; the same held true for cows which had never suffered from mastitis. The previously mentioned considerations with regard to the limitations of the method of detection apply here also; yet if there were a definite connection between the inhibitory streptococci and udder-disease one would have expected to find the organisms in greater numbers and more constantly in diseased udders.

Examination of various Materials for Inhibitory Streptococci.

Various possible sources round a milking-shed were investigated in an attempt to find inhibitory organisms elsewhere than within the udders of cows. The outside surface of udders, cow-hairs, cow-dung, water, and ensilage were all examined.

Flasks and beakers of sterile milk were placed under the udders of cows, and in some cases the udders were rubbed so as to cause dust to fall into the vessels below. Sterile swabs of cotton-wool were rubbed on the surface of udders and then immersed in sterile milk. In all cases the milk was incubated at 30° C. until clotting took place, when examination by the methylene-blue method was carried out. Inhibitory organisms were detected in four out of sixty-five samples.

No inhibitory organisms were detected in four experiments in which hairs from the udder and tail were immersed in sterile milk.

Seventeen samples of water drawn from various points around the milking-shed all gave negative results.

Two samples of cow-dung out of fifty examined gave positive results.

Mr. W. H. Udy's observations on the occurrence of inhibitory streptococci in silage were confirmed. Positive results were obtained in three out of five examinations.

It is evident from the above results that the inhibitory streptococci are widespread, but that in all the materials so far examined they occur only irregularly and in small numbers. They are thus similar in their occurrence to *Str. lactis* and other normal lactic streptococci.

Discussion.

It is apparent that inhibitory streptococci in small numbers may find their way into a milk-supply either from within the udders of certain cows or as the result of contamination of the milk from several outside sources. In daily samples from a good-quality supply the organisms were found more frequently in the summer than in the winter. This is readily understandable. More cows are in the herd in the summer, and thus there is more chance that at least one animal is delivering milk containing the organisms. Moreover, in the warmer weather there is more chance of the streptococci establishing themselves temporarily in the milking-machine, even though it be carefully cleaned. Yet another possibility is infection of the milk from silage fed to the cows. The large number of positive results obtained in January, 1935 (Table 2), may have been due to this factor.

But the number of inhibitory streptococci present in milk produced under careful conditions and cooled adequately could never be sufficient to cause any trouble in commercial practice. Trouble occurs only where the organisms are allowed to find a secondary habitat in the machine and utensils so that each batch of milk which passes through the machine is heavily inoculated. Inadequate cooling then permits growth to such a degree that the inhibitory products render the milk unsuitable for the growth of a normal "starter." It seems probable that the inhibitory streptococci are as widespread as the normal lactic streptococci. At any rate, the investigations described here failed to demonstrate any sources where the organisms occurred regularly in large numbers.

Summary.

Streptococci which produce a substance inhibitory toward normal lactic streptococci occur quite frequently in small numbers in normal milk-supplies. An enrichment technique enabled their presence to be demonstrated simply and quickly. An attempt to determine the source of the organisms showed that they probably existed within the udders of some cows, and that they could also be found in cow-dung and silage, and on the coats of the animals. In all these sources they occurred irregularly and in small numbers. A correlation could not be detected between the occurrence of inhibitory streptococci in the milk and the incidence of udder-disease in the cows.

References.

(1) Whitehead and Riddet (1933): *N.Z. Jour. of Agric.*, *46*, 225.
(2) Whitehead (1933): *Biochem. J.*, *27*, 1793.
(3) Cox (1934): *N.Z. Jour. of Agric.*, *49*, 231.

SURVEY OF PRODUCTION OF IRRIGATION FARMS ON GALLOWAY FLAT, CENTRAL OTAGO.

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PRIOR to irrigation Galloway Flat was practically unproductive, with a carrying-capacity of possibly one sheep to 10 acres, the vegetation consisting mainly of scab-weed (*Raoulia lutescens*) and odd stunted tussocks. The rainfall is about 12 in. per annum, with the majority of this falling during the winter months, when the temperature is often below freezing-point for many days on end, while in the summer the average temperature is above that of most parts of New Zealand, averaging from 75 to 85 degrees F. during these months.

With the advent of irrigation the scene of Galloway Flat has changed completely, from a semi-arid and barren region to a good dairy-farming district carrying splendid pastures and good lucerne stands.

The data in Table 1 have been obtained from seven dairy-farms and one sheep-farm on the Galloway Flat.

Table 1.

Actual Area, in Acres.	Area in Lucerne, in Acres.	Total Area in Grass.	Area of Grassland closed up for Hay.	Area in Roots, &c.
18	3½	14½	4	..
92	18	74	..	..
90	20	57½	..	2½
65	18	47	..	¼
65	20	45	..	..
92	18	74	4	..
52	10	38	4 red clover	¼
55	..	45	10 red clover	..

The feeding of stock usually commences early in June and continues until well into September, and, as can be seen from Table 1, lucerne hay is the main fodder, and it is supplemented with a little grass or clover hay. On three of the above farms the first cut of lucerne is converted into silage. All the lucerne is saved for winter feed, except, possibly, the short growth produced after the last cut, which may be grazed off. Up to the present, roots have not been grown to any extent, and the roots that have been produced are usually fed to pigs. Good crops of both mangels and carrots are grown successfully, and root-growing will probably become more of an established practice on the Flat.

The 90-acre farm with its 30 acres of lucerne is the only one in a position to sell hay, and it does so each year. With a third of its area in lucerne it is practically the only farm which each year has definite reserves of hay or silage.

MANAGEMENT AND PRODUCTION OF FARMS.

Table 2 gives data relative to the production and general working of the above farms, and, as a common basis is required on which to make

comparisons, Table 2 has been based on a 100-acre unit. Consequently a per-acre figure is readily obtained by shifting the decimal point two places to the left.

Water.—This naturally varies, depending on the class of land, crops grown, and the depth of loam which is covering the gravel subsoil. Where the gravel actually comes to the surface, a large volume of water is required to cover the field. On the eight farms an average of 116·8 day cusecs per 100 acres have been used, this being equivalent to 27·75 in. The water used ranges from 0·83 cusecs to 2·11 cusecs per acre, or 19·72 in. to 50 in. of water per acre.

The 18-acre farm demonstrates the fact that a relatively small area can be irrigated more economically than a larger area, provided the soil-type is the same, because a smaller head of water is required and the work of distribution can be dealt with more effectively.

Again, on the 52-acre farm 2·1 cusecs have been used per acre, in comparison with 0·8 cusecs per acre on the 18-acre farm. This is found to be due mainly to the fact that the shingly subsoil reaches the surface over a comparatively large area of the 52 acres. None of the other farms have the same relative area of gravel or shingly soil coming to the surface, and this is reflected in their consumption of irrigation water.

The systems used for irrigating are —(1) Border-dyke on all the flat areas, these having been laid down in permanent pasture—lucerne or red clover ; (2) on the permanent-pasture slopes which rise up on the side of the flat, flooding from contour ditches is carried out ; (3) Furrow-irrigation is carried out in producing root crops and in vegetable gardens, &c.

Butterfat.—Butterfat production has been calculated from the actual factory returns only. The average production per 100 acres is 12,484·3 lb., or 124·8 lb. per acre. The range in production per farm is from 88·6 lb. to 166·6 lb. per acre. Here again the small holding shows to advantage in butterfat per acre, and also in cows per acre, although the average butterfat per cow is beaten by three other herds. The high butterfat-per-acre figure of the small farm is due to smaller paddocks allowing intensive and rotational grazing, which gives more efficient control of pastures. On the larger farms the management is not so intensified, and as the season advances the grass-growth tends to become tufty with roughage or tends to get ahead of the stock, thus losing some of its nutritive value as compared with short well-controlled pastures.

The average butterfat per cow is 245·5 lb., and the range is from 192·25 lb. to 283·5 lb. per cow.

Stock carried.—The average number of stock carried was 49·7 dairy cows, plus 37·9 dry stock (which includes horses). Only one dairy-farm carried sheep, and this at the rate of 78·8 per 100 acres. The average number of pigs carried was 19·5 per 100 acres, or 1 pig to 2½ dairy cows.

Stock-food.—Very little stock-food was bought or sold. Good supplies of hay and silage are produced on the holdings, and these form practically the only source of winter fodder.

Fertilizer.—Superphosphate is the only fertilizer used and the use of this is not really general, as any response from superphosphate is usually masked by the large response always obtained from irrigation. The

Table 2—Farm Data, calculated per 100 Acres.

Actual Area, in Acres.	Actual Number of Workmen.	Water Day-cusecs.	Total Butterfat, in Pounds.	Butterfat per Cow.	Number of Milk Cows.	Number of Dry Stock, including Horses.	Number of Pigs.	Number of Sheep.	Stock-food bought or sold.	Fertilizer used, in Tons.
18	1	83·3	16,666·6	250·2	66·6	51·4	..	..	..	..
92	3	125·0	13,554·3	283·5	47·8	25·0	13·5	78·8	Bought 4·3 tons hay ..	..
90	2	103·3	13,577·0	271·5	50·0	42·2	29·3	..	Sold 18·8 tons hay ..	..
65	2	104·6	8,863·0	192·25	46·1	76·8	21·5	..	Bought 0·77 tons oat dust	..
65	2	104·6	9,860·0	200·4	49·2	13·8	30·7	..	..	3·1 tons super.
92	3	102·5	13,254·3	312·4	42·4	41·0	12·5	..	..	6·5 tons super.
52	2	211·5	9,615·3	208·3	46·1	15·3	29·4	..	..	..
55	1	100·0	..	..	..	..	..	515·09	..	3 tons super.
529 (totals) ..	..	934·8	87,390·5	1,718·55	348·2	265·5	136·9	..	..	..
66 (averages) ..	..	116·8	12,484·3	245·5	49·7	37·9	19·5	..	..	..

soils of Central Otago have been derived mainly from mica-schist, and different writers* have shown that the amounts of lime, potash, and phosphoric acid in these soils are particularly high, and that practically all that is required at present in these highly fertile soils is water.

SUMMARY.

Because of irrigation there is being produced on 100 acres of the Galloway Flat by two to three men 12,484 lb. of butterfat annually from 50 cows. In addition 38 dry stock, 20 pigs, and 10 sheep are being carried with practically no stock-food bought and only a little fertilizer used.

On the farm which runs only sheep, the carrying-capacity for the year is 5·15 sheep per acre. Actually it is much higher than this during those months when the lambs are being carried and fattened. The procedure followed is to buy ewes at the autumn sales and carry them until about the following February, when both ewes and lambs are sold off the pasture as fats. The farm is then given approximately two months complete spell until ewes are again bought in at the autumn sales.

(In the above figures are included all the young stock produced or sold during the year, and these are estimated as twelve months old by the addition of the total ages in months divided by 12—*e.g.*, 60 lambs at five months old equals 25 sheep, or 20 porkers five months old equals $8\frac{1}{3}$ pigs.)

* N.Z. Department of Agriculture Bulletin No. 120, by Tennent and Marks, pages 6 and 7.

The Instructor in Agriculture, Dunedin, reports that at Palmerston South certified seed of Arran Chief potatoes yielded a 50-per-cent. heavier crop than uncertified seed of the same variety grown in adjacent rows and treated similarly.

Certified Cocksfoot grown on Akaroa Peninsula.—In an article on seed certification published in the *Journal* for November, 1935, a comment in regard to cocksfoot-seed on the Akaroa Peninsula requires re-wording to prevent misinterpretation. The third sentence in the first paragraph under this heading should read: "The proportion of seed certified on the Akaroa Peninsula, under the immediate supervision of the Akaroa Cocksfoot Growers' Association, *in relation to the total quantity certified in New Zealand*, has fallen considerably, despite the fact that the total *certified* produce from this district shows a considerable increase."

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SEASONAL NOTES.

THE FARM.

Management of Established Pastures.

CONSIDERABLE field experience indicates that over a wide range of conditions some at least of the pastures on farms usefully may be top-dressed with phosphates during the latter part of summer or in autumn. Rain may be expected at this period, but, if dry conditions prevail, the action of the phosphates simply is largely deferred. On the other hand, if the rainfall is adequate, such application of phosphates immediately stimulates additional growth and puts the farmer in a stronger position for facing the critical winter period. Further, the phosphates, even superphosphate, which is of quickest action, when applied in the fall are not exhausted quickly, but bring about materially increased growth during the following spring and summer. When transport and distribution of fertilizers in the spring are likely to be hampered by wet conditions, as, for instance, in some hilly country, and when the prospective supplies of winter and spring feed are scant, fall top-dressing becomes particularly desirable. Similarly fall top-dressing is proving very effective in some relatively severe dry districts, such as parts of Canterbury, where a substantial portion of the summer and autumn is characterized by light-rainfall conditions under which fertilizers have little or no effect on growth of pastures.

About February, mowing of grassland may be advisable because of various circumstances. There may be a need to remove the flower-heads of perennial weeds, or there may be a need to "top," by light mowing, portions of pasture-growth which are rank and producing seed, in order to bring about the development of fresh leafy growth from the base of the topped plants. Sometimes, and especially after a winter or spring in which poaching or over-grazing takes place, pastures are overrun by large numbers of shade-creating weeds such as spear thistles, docks, fat-hen, and red-shank or willow-weed. If these weeds are ignored they are likely to weaken greatly the pasture-plants in their vicinity and probably create vacant patches on which inferior plants become established eventually. Mowing of them, however, minimizes their shading effect by which they injure the valuable pasture-plants.

A widespread need continues to be increased attention to the quality of the production of the pastures in the latter part of summer. In January and February usually any weakness in pastures as a source of feed for "wet" stock is more likely to be on the score of quality rather than of quantity, and the lack of quality is correlated with the stemminess in the growth which is so common. Both the top-dressing and the "topping" in the manner described above tend to obviate the stemminess and to induce fresh leafy growth. The more special non-woody crops, such as soft turnips, green lucerne, millet, &c., are dispensed with the greater is the need to take measures which provide the greatest practical amount of leafy growth on pastures. The more grassland is depended upon as the direct source of feed the greater is the likelihood of late summer proving a critical period in live-stock husbandry, and particularly is this so in dairying. The use of silage at this season serves to relieve the position to some extent, but silage as normally available contains so much stemmy material that it is far from ideal as the dominant constituent in the rations of cows of fairly heavy to heavy production—a fact which has been well demonstrated in dry summers when acute lack of other feed has forced farmers to feed silage freely to dairy cows.

Pasture Establishment.

The preparation of the ground for autumn sowing of pastures is an important summer task to which considerable reference was made in these notes last month. Lack of fineness and firmness of the seed-bed are common causes of poor results in pasture establishment. Fineness, and particularly firmness or consolidation, cannot be secured readily unless the work is commenced in good time. Clovers, which are essential in successful permanent pastures, call especially for consolidation.

Recent years have been marked by a changed outlook in respect to the constitution of pasture seed-mixtures for use in districts which enjoy a rainfall suited in its distribution and amount for effective use of fertilizers on grassland—such is the rainfall of much of New Zealand apart from the particularly dry districts. The natural plant-food supply of the soil has declined in importance as a consideration, when deciding upon the composition of a pasture seed-mixture: this is because, when rainfall is not the limiting factor in production, the original fertility of the soil can be altered so readily and radically by top-dressing that often the ingredients that should be used in a grass-seed mixture become dependent more upon the proposed top-dressing programme and the rainfall than upon the natural fertility of the soil. It often proves advisable to bring the fertility of the soil up to the requirements of a high-class seed-mixture by appropriate top-dressing rather than to use a seed-mixture with lower requirements co-ordinate with the natural unimproved fertility of the soil. As an illustration of this, land the fertility of which is more fitted to the requirements of cocksfoot and dogstail than those of rye-grass at times may well be sown with a mixture suited to provide a rye-grass-white-clover-dominant pasture, it being intended to increase the standard of fertility to rye-grass requirements and to maintain it at this standard by suitable top-dressing. Because of the change in outlook seed-mixtures which were considered the best a few years ago for certain conditions may not now be so considered. Farmers at all uncertain on this matter are likely to find it well worth while to seek the guidance available from district officers of the Fields Division of the Department of Agriculture. One of the principal matters in this connection is that proven superior strains of important pasture species are commercially available, and that if these species are to be used it is exceptional for the use of anything but the proven superior strains to be justifiable economically.

In general, because there are now available better seeds and a greater knowledge of top-dressing, it is reasonable to expect that pastures intended to be as permanent as possible will be of longer profitable life in the future then they have been at times in the past. It follows from this that the preparation of the seed-bed and the composition of seed-mixtures are now of greater importance than formerly—any weakness creeping in at the outset will exert its undesirable influence over a greater number of years.

Where the grass-grub has been in evidence it calls for consideration. The more herbage land carried during the period November to January the more is it likely to be infested with grass-grub, and so, in districts subject to grass-grub depredations, it is not altogether desirable to sow down pastures after a cereal or a previous crop of grass.

Some Measures to Control Rushes.

While the desirability of mowing certain weeds has been mentioned above, mowing as a means of controlling rushes has some special features that call for particular mention. When the ingress of rushes is due primarily to persistent bad drainage, then one can expect to effect little in the control of the rushes simply by mowing them. But it is to be borne in mind that the presence of rushes even in considerable numbers is not necessarily due to poor drainage. In some instances rushes have obtained

a foothold in pastures on fairly well-drained land right at the outset because of some degree of failure during the early stages of establishment due to, for instance, the use of seed of poor germination capacity. Similarly, on land of quite good drainage the use of seed of a non-persistent strain has been associated with the early ingress of rushes on grassland, whereas rushes have not established when seed of a persistent strain has been used. Again, rushes have freely invaded pastures of considerable age on reasonably well-drained land when these pastures have become weakened and more open because of lowered soil fertility or of prolonged periods of over-severe grazing. The fact that pasture-management factors apart altogether from drainage may greatly influence the amount of trouble from rushes is at times well illustrated in the field when adjacent to a pasture practically free from rushes occurs another pasture heavily invaded by rushes despite the fact that the drainage of the two pastures is practically similar. Mowing of rushes not due essentially to bad drainage has been tried fairly extensively with varying results. Such mowing of rushes in January or early February has proved of substantial service in controlling them, while mowing at a considerably earlier or later date has been much less effective. It would seem that in the Manawatu district, at least, rushes are most suspectible to weakening by mowing shortly after midsummer, and, while it is likely that what applies in the Manawatu applies also in most other districts, only actual field experience can provide definite information on the point. The good results noted in the control of rushes by mowing have been obtained only when mowing at a suitable date has been accompanied by conditions which maintain or produce a vigorous sward with a tendency to become more dense rather than more open. Hence good results are not to be expected from the mere mowing of rushes invading an open somewhat weak pasture. On the other hand, mowing of a sward which has been invigorated by top-dressing and on which good grazing has been practised, while not eradicating the rushes, has reduced their development so much as to bring about practical control of them—the small clumps of rushes that continue to persist do not influence materially the growth of the pasture. In short, the economic control of rushes at times is to be obtained not directly by any one measure such as mowing or top-dressing, but by several measures interacting in such a manner that the rushes are weakened by, say, mowing at about the same time as the pastures are strengthened by top-dressing and rational grazing treatment.

Control of Weeds in Summer.

Often during summer it proves decidedly profitable to give attention to certain measures which assist in bringing about the control of weeds: this applies particularly to farms on which land is under the plough.

At times, and especially in the South Island, weeds should be considered when future cropping is being planned. For instance, land may be foul with annual weeds such as fat-hen, spurrey (yarr), and nightshade, which germinate in the spring and early summer rather than at other seasons. Cropping should be arranged, if at all practicable, so that such land is sown in the autumn instead of in the spring. The influence of date of sowing on weed control is well exemplified when wheat is grown on land infested with seeds of fat-hen: usually the fat-hen is not much in evidence in autumn-sown wheat, while it is likely to be prominent in spring-sown wheat. Similarly, turnips or spring-sown oats may be badly affected by spurrey, whereas autumn-sown oats or temporary pasture may receive no injury from this weed. Further, it should be remembered that if trouble from annual weeds is avoided for one season by autumn sowing, the land does not thereby become free from weed seeds: field experience shows forcibly that the seeds of many weeds including fat-hen, spurrey, and nightshade, are capable of persisting alive and vigorous when buried in the soil for many

years. Because of this, land which is known to be foul with seeds of weeds should be kept in pasture, if the pasture is satisfactory, as long as it is practicable to avoid ploughing it.

Certain crops such as potatoes, mangels, swedes, and carrots, which are grown in rows wide enough apart to allow of intertillage, have been called " cleaning " crops, because of the opportunity they offer of getting rid of weeds. Such crops should be made " cleaning " crops in fact as well as in name: often they are cleaning crops in name only, since once the main invasion of weeds has been dealt with succeeding invasions, which are sufficient to foul the land badly even if they do not appreciably lower the yield of the crop, are neglected. Often February is the time when such neglect occurs.

Summer fallowing is at times recommended as a standard means of exterminating weeds generally. Actually it has been dispensed with widely because it is impracticable as a sole means of destroying weeds difficult to deal with: except under the conditions most favourable to it, and these are not of wide occurrence, it is likely to be both expensive and disappointing. Usually the summer fallow is recommended for and has been employed against " twitchy " weeds such as couch-grass, brown-top, creeping-fog, sorrel, yarrow, and Californian or creeping thistle. Experience has shown definitely that, while summer fallow at times may lead directly to the eradication of such weeds, it requires so much labour as usually to become too expensive even when successful, and, further, that in many cases no matter how much labour were devoted to summer fallow it would not be effective enough.

From this it is not to be deduced that summer cultivation is useless in weed control. The position is that summer cultivation should be succeeded by other suitable practices to obtain the fullest possible value from it. For instance, summer cultivation during a dry period may considerably weaken a perennial twitchy weed, but on the return of moist conditions the twitch may become vigorous and give trouble again unless it is subjected to further weakening. Hence the summer cultivation during a dry period should be followed by the immediate sowing of a crop which grows quickly and densely. Such crops have a weakening effect by excluding direct sunlight, which is of as vital importance to practically all weeds as it is to farm crops generally. At times autumn-sown Algerian oats or Western Wolths rye-grass and red clover prove suitable for this purpose. If after such a crop the weeds still call for further weakening, it may be advisable to grow a well-nourished well-tended forage crop, such as chou moellier, rape, mangels, turnips, &c., which is able to compete successfully with the weeds for the supply of direct sunlight. In short, a suitable rotation of crops which all the time pays its way and which is spread over a number of seasons rather than expensive summer fallow is the economic modern method of eradication of perennial weeds.

Sometimes, as in the case of old pastures, it is known that the surface of land is badly infested with seeds of weeds. Such land, having been ploughed, should be so cultivated subsequently that the buried former surface layer is not again brought to the surface. While seeds of weeds which are buried to a depth of several inches may not be destroyed, they do not germinate, and as long as they do not germinate they do not affect crops. This point is of considerable moment in the preparation of land for such crops as mangels, lucerne, and carrots, which are particularly apt to suffer from weed-infestation.

Often indirect attack on such weeds as sorrel, brown-top, creeping-fog, and similarly " twitchy " weeds is most advisable. Suitable indirect attack often consists of sowing the land in pasture and then by appropriate top-dressing and management making the conditions so favourable to the pasture that eventually the valuable species outgrow the weeds to such a degree that the weeds, while not eradicated, are of little or no consequence.

The Breeding-ewes.

In fat-lamb production in the North Island the rams are usually put out at the end of February or in early March. If there is likelihood of the ewes being too fat, they should be put on scant rations early enough to have their condition appropriately lowered prior to the flushing, which is advisable for a period of a week or ten days prior to the rams going out. Flushing can be effected by providing some succulent feed as by putting the ewes on the best short pastures available or by putting them on rape after the first feeding-off by the lambs.

Work with Crops.

The current work in respect to the utilization of crops and to forage and general cropping is covered broadly in last month's notes. The avoidance of an unduly rapid decline in the daily production of butterfat during February is a task of particular moment. Crops which prove valuable in this task are young leafy red clover, or lucerne before it has developed woodiness and before there is any flower-production, young millet, and soft turnips. By leaving them longer uneaten some of these crops would produce heavier yields. But the returns from a crop are not determined solely by its gross yield. In the first place a light crop, say, 15 tons an acre of turnips, used when it is badly needed may prove more valuable than a heavier crop of from 20 tons to 25 tons an acre used when alternative feed is freely available. In the second place, greater maturity and yield in the case of crops such as lucerne and millet often are linked up with a falling-off in nutritive value of a given quantity of the forage because of lowered digestibility or of poorer balance of ingredients.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Pest and Disease Control.

THE coming few weeks heralds the close of the spraying season. Sometimes when the harvesting season commences spraying is neglected and necessary sprays are not applied because it is somewhat inconvenient to apply them at that time. While there may be times when this practice does not result in an increase in disease, it is an unwise risk to take, for more often than not the omission results in greater damage by disease or pest than would otherwise obtain—especially is this true of late infection of black-spot in wet seasons or during periods when dews occur, and of the ravages of leaf-roller caterpillar. The recommendations relative to the treatment to apply during the month are set out in previous months' notes and in Bulletin No. 161 entitled "Control of Orchard Diseases and Pests by Spraying," and obtainable from the Orchard Instructor for the district or the Department of Agriculture, Wellington.

Harvesting the Crop.

The importance of care in the preparation of fruit, for either local or export markets, cannot be emphasized too strongly. Considerable losses accrue through faulty handling during the picking, grading, and packing operations.

The picking of the crop, whether it be stone or pip fruits, calls for considerable discretion and care on the part of the picker. Carefully picking to size and eliminating the culls greatly facilitates the work in the packing-sheds. Rejected and fallen fruit should not be allowed to remain on the ground, but should be gathered up, and, if not utilized, should either be deeply buried or destroyed.

Attention must also be paid to maturity, and several pickings should be made, removing the fruits which have reached the required degree of ripeness for the market it is intended to supply. The more distant the market the earlier the fruit should be gathered to ensure its arrival on the market in good marketable condition. In gathering fruit intended for export attention should be directed to the degree of maturity rather than colour. Much has been written about the necessity of picking to colour and colour standards, but this is apt to be misleading to the grower or picker, as, while the fruit remains on the tree to attain a high colour, it may become over-mature for transport to the market.

Select early pickings are of great benefit, as the removal of the mature and larger fruits accelerates the sizing-up of those remaining and also tends to improve the colour of such fruit. The fruit should be carefully removed without damaging the fruit spurs or tearing out the stalks from the fruit. When picked, the fruit should not be left standing in the sun, but removed as soon as possible to the packing-shed.

Grading and Packing.

Stone fruits require an absolute minimum of handling. Where careful pickings have been made it is possible and also wise to grade and pack at the one time direct from the orchard-box.

These fruits should be packed and despatched with a minimum of delay. For good-quality lines of the larger-sized fruit, especially where consignments have to undergo long transit, the use of trays instead of cases is recommended.

The grading of the export crop requires skilled knowledge on the part of the grader. Where labour for hand-grading has to be employed, every endeavour should be made to obtain suitable operators, as a great deal is dependent upon their reliability and quickness. If mechanical sizers are in use, the rollers, carriers, belts, bins, fruit-hoppers, &c., should be cleaned once a day in order to remove as far as possible any grit or other material likely to cause scratching and superficial marking of the fruit. Scrubbing with a stiff wire brush the parts of the grader with which the fruit comes into contact removes the natural oil of the fruit which adheres to these parts, and which, if not removed, collects dirt and grit and causes the scratching of the fruit.

The packing-bins should not be over-filled, as this is likely to cause considerable bruising, skin-punctures, and scratching of the fruit. These injuries are frequently caused by the "raking-down" of over-full bins.

The shed conditions should be of the best, and the layout should be so arranged as to ensure ease in handling and to avoid confusion. Culls and waste fruit should not be allowed to lie about the shed, but should be removed and dealt with in such a way that they do not become a nuisance.

The packer of fruit for export should pay attention to securing a correct pack. The pack should be consolidated as the case is being filled, and this will tend to tighten up the apples in the centre of the layers, as well as firmly settling the fruits in the pockets, with the result that the centre of the top layer will be above the fruit at either end of the case. The finished pack should not be more than ½ in. above either end of the case, or more than 2 in. above in the centre. This will facilitate lidding, without bruising the end apples—a somewhat frequent occurrence when the end apples are too high. Cases which are either too low or too high in pack should be rejected and returned for repacking.

In reference to packing, the terms "slack," "low," "tight," and "high" packs are often misunderstood. A slack pack is not necessarily a low pack—in fact, it might even show excessive bulge and yet be slack—a point not sufficiently realized. Slackness is the result of failure to consolidate the pack, and when the cases have received some handling the fruit is shaken

into place and a "rattle" develops. A "tight" pack of correct height will not rattle until appreciable shrinkage has taken place in the fruit, while a "high" pack is one in which the height of the bulge at the centre when it leaves the packer is greater than 2 in. above the edge of the case or more than ½ in. at close to the ends of the case.

Before lidding, cases when packed should not be placed on the floor or other flat surface. If this is done the bulge on the bottom of the case is forced up and the pack loosened, and the benefit from the consolidation of the pack thereby lost. Some convenient means of avoiding this usually can be devised readily.

The wiring, labelling, and stamping should be carried out with care, to ensure that the package has a neat and tidy appearance.

—R. G. Hamilton, Orchard Instructor, Hamilton.

Citrus Notes.

On account of the possibility of a dry period being experienced, every effort should be made to conserve as much moisture as possible. This can be done best by maintaining a clean state of cultivation and by working the soil to a depth of from 3 in. to 4 in. as a mulch. Wherever possible rough litter such as dry hay, straw, &c., may be spread over the surface of the rooting-area, but should not be allowed to come in contact with the tree-trunk. This material prevents excessive evaporation, assists in maintaining a more equable soil temperature, and eventually becomes available as a plant-food when it decays and becomes incorporated in the soil.

In some groves irrigation may be necessary. As citrus trees make their greatest demand on the water-content of the soil during the period when a minimum rainfall is usually experienced, steps should be taken to ensure that sufficient moisture is provided. Without the necessary moisture satisfactory growth and fruit-development cannot take place. All fruit sufficiently matured should be harvested so as to give the trees every chance to set the coming crop, otherwise much young fruit will drop which would have remained on the tree to produce a good spring crop.

On young trees where extended growth has taken place pinching should be carried out so as to force an early subdivision of leaders. If left to mature without attention vigorous shoots often grow to a length of 3 ft. or more before dividing, and eventually leave an undue length of wood unfurnished.

Should humid conditions prevail, it will be necessary to apply a further Bordeaux (3–4–50) spray as a check to verrucosis on the maturing crop.

Where red-scale is prevalent January is the month to apply the first spray of summer oil (1–33), mentioned in September notes.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

General Considerations.

RECENT statistics showed that 154,221 persons, or approximately 50 per cent. of the householders in New Zealand, kept poultry. The returns further showed that 117,988, or approximately 77 per cent., of those householders kept under 25 fowls, and only sixty-six householders kept 1,000 fowls or over at that time.

The indication is that the greater bulk of the eggs and poultry produced in this Dominion comes from the farmers or small producers, and this no doubt will continue to be the position, although in recent years there appears to be a tendency in certain centres for more people to take up poultry-keeping on a larger scale.

If it is intended to take up poultry-keeping on a commercial scale the selection of site calls for very careful consideration. The ideal class of soil on which to keep poultry is a sandy loam with a gravel subsoil—a soil which produces a good growth of grass, the gravel subsoil allowing of a good free drainage. It is an advantage to have a site which has a slight slope to the north, and which is sheltered from the prevailing bad weather by either natural shelter or a belt of trees. Such ideal sites are, of course, not easy to find, but it is well to bear in mind that environment plays a very large part where poultry are concerned, and heavy damp soil or exposed bleak situations should be avoided. Even on some farms where only a comparatively small flock of birds is kept, if more consideration were given to the selection of the site for the poultry-houses and runs the poultry-keeping would, in many cases, prove a more profitable and interesting venture.

Another point that requires careful consideration when selecting a site for a plant is the distance from a good market, and the average price of foodstuffs in that particular district. Generally speaking, the profit over the cost of production, even under the most favourable circumstances, is such that if valuable time has to be taken up in the carting of produce to and from the market, instead of attending to the more important work of production, or if heavy freights have to be paid, much loss may result.

Experience has shown that the most successful poultry-farmers are amongst those who have either started by keeping a few fowls as a hobby and gradually built up their flock as experience and knowledge were obtained, or who first spent some time on a successful poultry-keeper's plant before starting out in business on their own account. Unfortunately some have started in the business and found that they were unable to make a success of the venture, and in a number of such cases those concerned have failed to appreciate the fact that poultry in large numbers is one of the most difficult classes of live-stock to handle profitably, or that poultry-farming is a highly skilled occupation, and is even more dangerous financially to undertake without experience than other branches of production. It is desirable if a person wishes to take up poultry-keeping on a commercial scale to first obtain some practical experience on the run of a successful poultryman, or start in a small way and gradually build up as knowledge and experience grow.

Culling.

One of the most important jobs a poultry-keeper should learn is how to cull his flock correctly. Generally, February is about the best month during which to undertake the main culling for the year, as few, if any, of the good birds should have started to moult by that time. Many poultry-keepers now realize the value of culling, and most of the successful commercial men cull regularly throughout the year, as this has been found necessary in order to keep the flock on the best paying basis. A number of poultry-keepers cull only once a year, during the autumn, because they do not feel satisfied that they could make a satisfactory job of the business at other times.

The art of culling is not simple, as it calls for keen observation, much practice, and experience. It really means the balancing or correctly weighing of the various points, as no one point or factor can be depended upon under all conditions. For instance, the early moulters are usually looked upon as weak birds and poor producers, but if a flock has been underfed, or subject to any sudden change of feed, say, about December, many good birds may have been forced into an early moult. Therefore such points must be taken into consideration when estimating the producing-capacity of such birds.

The most difficult flock to cull correctly is one that has been mismanaged at some time during the year, and contains birds of various ages, and it is

only a person with considerable experience who is likely to make a satisfactory job of the culling. Provided the birds have been well cared for, the following factors are worthy of attention when culling: The first thing to look for in any bird is a good constitution, and as physical activity is one, if not the chief, evidence of vitality and health, this characteristic should be given first consideration. It will be found that birds of good constitution are quick in movement, constantly on the hunt for feed, and are the first off the perch in the morning and last on at night. In fact, they never seem satisfied with what is given them, and if on free range will often be farther away from the fowl-house at dusk than other birds.

On the other hand, birds of poor constitution and invariably poor producers are generally slow-moving and sluggish, spend a good deal of time on the perch, and are either over-fat or too thin. Such birds should be culled.

The time of moulting is the next important factor, for experience has shown that the best producers are usually the last birds in a flock to shed their feathers, so birds that are still laying at the middle of February may be retained for a further period, provided, of course, that they are not over two and a half years old, while those going into a moult before this period may in most cases be culled.

The heavy producers and those that may be retained for a further period will possess the following characteristics: Comb fairly full, warm, waxy, and red. Eyes large, bright, full, and prominent. Abdomen is deep, at least three fingers' width between the pelvis and end of the keel bone, with texture soft, thin, and pliable. The pelvic bones are thin and flexible, with a spread of at least two fingers' width between them. The vent is large, moist, and of a flesh or pinkish colour. With Leghorns and other yellow-legged breeds, the beak and legs are of a pale or flesh colour at this period of the year. Feathering is hard, tight, dense, and often of a worn threadbare appearance, while many good Leghorns have a more-or-less straw-like tinge in the feathers towards the end of a heavy laying period. The poorer birds and those not producing, usually may be detected by the following characteristics: Comb small or shrunken, cold, and more-or-less hard. Eyes small, listless, and sunken. Pelvic bones thick, coarse, and stiff, with less than two fingers' width apart. Vent dry and small and puckered. Abdomen shallow, with less than three fingers' width between the pelvic and breast or keel bones. At times some birds of the heavy breeds may show depth of abdomen, but the texture, with poor producers, will generally be found to be coarse, with a layer of fat beneath the skin. If over-fat, Leghorns and other yellow-legged breeds can usually be picked by their yellow legs and beaks at this time of the year, and such birds should be culled. However, allowance must be made for any birds of the yellow-legged heavy varieties if they have been broody, for the colour usually returns to the beak and legs when a bird is sitting.

Since the inauguration of laying competitions in this country during 1905, where birds are individually tested, much useful and interesting information has been obtained. Not only have we learned the wonderful producing-capacity of the hen when kept under suitable conditions, but, largely as a result of these tests and a careful study of the winning birds by keen observers, much knowledge has been gained, and if poultry-keepers who live in the vicinity of centres where these tests are being conducted could visit the grounds and observe the chief characteristics of the leading birds, they would no doubt observe points which would assist them when culling their own flock.

—C. J. C. Cussen, Chief Poultry Instructor, Wellington.

THE APIARY.

Extracting Operations.

EXTRACTING should now be in full swing in all districts of the Dominion. Where for any reason operations have been delayed, care must be taken to see that the bees are not crowded, or they will commence to loaf, and the ultimate crop will be small. It is a good policy to extract twice during the season, but where the beekeeper prefers to leave the work until the end of the flow a close watch should be kept so as to provide ample room. This, however, can be done only where large numbers of spare combs are kept on hand. It is during the season when honey is coming in freely that the beekeeper realizes that his most valuable asset, next to his bees, is a good stock of extracting-combs. Every effort should be made to get at least twenty spare combs for each hive in the apiary, and with this number on hand the bees are not likely to be hampered for room.

In the absence of plenty of drawn-out combs the best plan is to keep the extractor going, and thus prevent the bees from blocking the brood-combs. This usually happens unless ample room is provided, and, as a result, the queens are prevented from laying to their utmost, and the colonies dwindle. At no time during the working-season should the work of the queen be hindered. Care must be taken at all times to attend to this important item during the flow. The honey is quite ready to extract when the combs are three parts capped, but great care must be exercised not to extract unripe honey. Numerous instances have come under my notice where the taking of unripe honey has meant a total loss to the beekeeper.

Removing Honey from the Hive.

The usual practice followed when the time for extracting is at hand is to remove the frames one by one. If excluders are used much time will be saved in picking over the combs. As the combs are taken from the hive it is necessary to shake off the bees in front of them, to brush off any remaining bees, and to place the combs in a super for removal to the honey-house. The combs should be covered with a cloth which has been previously placed in water containing a small percentage of carbolic acid. When the season is at its height very little trouble will be experienced from robbers, but in case of a stoppage in the flow precaution is necessary. At all times the beekeeper should study his working-equipment, and this is highly important when removing the honey. It will be found convenient to provide a good barrow or truck for carrying at least two full supers. Much time and labour will be saved, and the tedious work of removing the honey will be facilitated.

Straining.

Some form of strainer should be used to catch the larger particles of wax, dead bees, &c., in the honey as it leaves the extractor and before it finally reaches the tank. It is a simple matter to strain the honey, and yet this important part of the work receives less attention than its importance demands. It should be the aim of every beekeeper to see that his product is rendered as marketable as possible before it finally reaches the customer. Wax is not a component part of honey, and dead bees are foreign matter, and yet they are frequently found in honey exposed for sale. Honey containing either is not likely to suit the buyer, and its selling-value is consequently reduced.

To ensure that all but the smallest particles of wax are removed, the honey should be run through a fine wire strainer, and finally passed through fine cheese-cloth before entering the tank. Cheese-cloth strainers are cheap and easily made, and should be cleansed after each day's operations. The strainers should be of such construction as to be easily cleaned, and if

the cloth is tacked into wooden frames the operation is greatly facilitated. Cold water should be used when cleansing the strainers; hot water melts the particles of wax, thereby clogging the holes in the cloth, whereas cold water removes all wax from the surface. It is advisable to hang the strainers up to dry, so that they are ready for use when required.

Good Honey-tanks essential.

No part of the apiary equipment is of more importance at extracting-time than a good tank. From the strainer in use it is advantageous to run the honey into a tank, so that the small particles of wax that pass through the strainers rise to the surface, when they can be skimmed off before finally the honey is drawn off at the bottom of the tank. Many beekeepers run their honey directly from the strainers into tins and small packages ready for sale, with the result that the small particles of wax rise to the surface, to the detriment of the honey and its sale. Frequently complaints are made about the quality of the honey, and not infrequently adulteration is suspected through an excess of these wax particles rising to the surface. Such honey should not find its way to market, its condition having been brought about by sheer neglect on the part of the beekeeper to provide adequate tank accommodation. By allowing the honey to settle in the tank the air bubbles escape, the small particles of wax rise to the surface, and in dry weather surplus water is evaporated.

The size of the tank to be adopted must be decided by the beekeeper himself, as it is hard to find two beekeepers with requirements alike in this matter. He must study his needs and convenience, but in any case the tank should hold enough to enable him to deal with the honey in the hives at the time of extracting.

Examination for Foul-brood.

Opportunity should be taken when removing the surplus honey to make a searching examination of the brood-chamber for disease. In this matter the beekeeper should ever be on the alert, and if disease is noticed in any of the colonies the surplus honey from these colonies should be set aside to be extracted when all other extracting is finished. Many beekeepers spread the trouble by careless handling of diseased colonies at extracting-time. The combs from infected hives should be sterilized with a 20-per-cent. formalin solution or destroyed after the honey has been extracted.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Vegetable Crops.

THE warm soil and occasional showers experienced during the autumn months encourage vigorous growth in young crops, and close attention is required to make the most of this opportunity. Many kinds of weeds reproduce only by means of seeds, and where these have been cut or destroyed before seeding the labour and cost of crop-production is greatly reduced. Young crops during autumn and winter require close attention to prevent competition from weeds. Where weeds are controlled, under suitable weather conditions, good growth is maintained until the individual plants in the crop cover the ground and are able to look after themselves to a great extent. Good spacing in which the constitution of the crop and the quality of the land have been considered is an important factor in achieving a desirable result. The crops concerned are chiefly winter crops of savoys, Brussel sprouts, broccoli, cauliflower, kale, leeks, and celery, which have been recently planted out, and late peas, beans, root crops, and salad crops

recently sown. A little sulphate of ammonia on heavy land or nitrate of soda on light land now in many instances gives a desirable impetus to growth. The frequent use of these fertilizers alone produces in the crop soft growth which is often predisposed to the attack of fungous disease or injury by frost. Where their liberal use is considered desirable potash should be included with later dressings with a view to preventing these undesirable results.

Crops of early celery approaching maturity may now be blanched by tying up the leaves lightly; removing suckers and dead leaves; applying such water and fertilizers as may be required; and, when the plants are dry, filling in round them well pulverized soil to a depth of 4 in. or 5 in. The moulding-up process should be repeated at intervals of a fortnight until completed. Self-blanching varieties planted in blocks on land with the surface at the ordinary level require only to have the light entering from the sides excluded to have the desired result. This may be done by placing 12 in. boards, or other material, on edge close up to the outside rows and fastening them securely in position.

Crops of spring cabbage and cauliflower for cutting at that season are sown in seed-beds during the month of February. A good strain of seed sown thinly and protected from the attack of pests will provide good plants for setting out about the month of April in a clean well-drained piece of land.

During the month of November the lower leaves on many crops of tomatoes under glass were lost by prematurely drying off. It is common and perhaps natural for a few of the lower and older leaves to behave in this manner, but in the cases referred to the great extent of the loss at that season was no doubt injurious to the crop. Mycological examination showed that no disease organism was present, and considering all of the circumstances there is little doubt that the condition was due to the plants at some time suffering from a lack of water in the soil. The difficulty of supplying this need during the colder months of spring is best met by thoroughly saturating the soil and subsoil shortly before planting out. With good management, especially as regards temperatures, little more water will then be required before the warmer weather arrives, and it can be applied with less danger of chilling the plants.

The harvesting of the tomato crop in the unheated glasshouse is now drawing to a close. So soon as it is finished no time should be lost in cleaning the house and preparing the land for another crop. The former is best commenced by sealing up the house and burning screened agricultural sulphur during a windless evening, using it at the rate of 2 lb. per 1,000 cubic feet of air space, and placing it in a number of heaps on the floor of the house so as to get a good diffusion of the gas. The next day, after airing the house, the plants are cut off a few inches above the surface of the ground, and, when reasonably dry, they are carried out, with the strings on which they are trained, and burnt. The house is then swept clean and the roots are carefully lifted, examined, and burnt. The knowledge thus obtained, together with the experience gained during the growth of the crop, gives a good idea of the diseases present and the quality of the soil—data upon which the further treatment must be decided. Where sterilization or change of soil is not required, the land can be cultivated lightly and sown in a green crop to be trenched in later. The problem of controlling plant-diseases may be greatly simplified by promptly burning all waste and infected material.

Small and Sundry Fruits.

Recent exchanges report an increasing popularity in Tasmania for the raspberry variety Lloyd George, which gained a high place in the variety trials at Wisley in England. Experiments are being carried out with the black currant varieties Boskoop Giant, Seabrook's Black, and Goliath, which also headed the list in English trials recently.

In warm localities in the north strawberries are planted towards the end of autumn with good results; but elsewhere it is generally best to set out the plants in early autumn as soon as the young plants are available, so that they are well established before the winter season. Soil suited to this crop is heavy, deeply worked, moist but well drained, and quite free from bad perennial weeds—the situation open but warm. With a heavy dressing of blood and bone manure and superphosphate ploughed under, the plants may be set out with good prospects of a satisfactory crop. As with other kinds of fruiting plants, varieties satisfactory in one district are often disappointing elsewhere. Those favoured in the north are Marguerite, Captain Cook, and Helenslea Surprise, while in the south strains of Melba, Laxton's Noble, and Ettersburgh are preferred. Good plants are required for the best results; they are of moderate size, well rooted, free from leaf-spot and other diseases, and of good strain—not spoiled by bad packing or kept too long out of the ground. When the surface of the ground is well graded and the soil settled firm, the plants may be set out about 9 in. apart and from 26 in. to 36 in. between the rows—the wider distance where the plantations are cropped for two or three years, especially where the matted row is favoured or horse-drawn implements are used. After planting it is advisable to take advantage of dry intervals to cultivate the ground lightly and destroy seedling weeds.

Seed of Cape gooseberries may be sown now to raise plants for setting out in the spring. The plants may be raised in boxes and kept in cold frames or cradles over the winter.

The Homestead Garden.

With the commencement of autumn rains the land is soon in condition for cultivation, and a commencement may be made to carry out garden plans which have been prepared. This is done by driving stout wooden pegs in the ground defining walks, drives, and service court, just as they are shown on the plan. These areas are then graded and formed in readiness for metalling, taking special care to destroy or remove all bad weeds. The remainder of the area is then given thorough cultivation to prepare it for sowing down lawns and planting trees and shrubs. This may be done by trenching or double ploughing, whichever is most convenient to obtain a good tilth. It is advisable to destroy all weeds, and to retain the fertile dark loam in its natural position—on top. The aim should be to complete this work in time for sowing lawns during the month of March and planting trees and shrubs during the months of May and June. If this is not possible it generally is best to be ready for carrying out these planting operations about the month of August.

The success attained depends to a very great extent on suitable levels and grades being set for the ground surface. It is generally advisable to make the surface *level* around the foundations of the house and to have a steadily falling grade from the foundations outward, so that all surface water readily drains away and does not lie in the vicinity. Sumps and culverts usually are required to dispose of water on drive and walks. In small gardens levels are set by driving wooden pegs at intervals of from 10 ft. to 12 ft. and adjusting them by means of a straight-edge and spirit-level, and extending them by means of boning-rods. A variety of problems arises in carrying out these tasks, and they should be dealt with by giving them careful consideration, as no other operation is more vital to the success of the undertaking.

Many bulbous and tuberous plants are best planted now; they include narcissus, scillas (bluebells), crocus, muscari (grape hyacinths), iris, and lilies so soon as they die down. In an alkaline soil the bearded irises make a rich display during spring and summer; in such localities they should be a feature in sunny positions. Crocuses—blue, gold, and white—are suitable for planting in turf composed of dwarf grasses; and scillas and

muscari form an excellent contrast with their blue flowers to the daffodils of spring, which run so much to yellows. Many bulbs may be dried off with impunity, and indeed many which are natives of countries with dry summers, such as Africa and Asia Minor, may be given dry warm storage with advantage; but lilies of all kinds are never dormant long and the bulbs should never be allowed to dry out. They must be kept moist while out of the ground and planted so soon as possible. Hyacinths, tulips, and many others which enjoy warm storage in a dry state should be held until about the month of April before planting.

Evergreen hedges trimmed now will quickly regain a good appearance and keep it for a long period.

—*W. C. Hyde, Horticulturist, Wellington.*

SALE OF PASTEURIZED CREAM BY DAIRY COMPANIES.

By an amendment to the regulations under the Dairy Industry Act, 1908, governing the sale of milk or cream for human consumption, which amendment came into force on the 12th December, dairy companies are authorized to sell cream for human consumption subject, however, to the following special conditions:—

(1) The cream must be either cream to which has been assigned the grade of "Finest" or cream taken from milk to which that grade has been assigned in terms of the Dairy-produce General Regulations, 1933.

(2) The cream must be pasteurized in conformity with the regulations under the Sale of Food and Drugs Act, 1908—that is to say, it must be cream which has been retained at a temperature of not less than 145° F., and not more than 150° F., for at least thirty minutes and immediately cooled to a temperature of not more than 55° F., and protected from recontamination. The cream must not be so heated more than once and must not be otherwise treated by heat. It must not contain any living coliform bacillus in one-tenth of a centimetre.

(3) The cream must be labelled in conformity with the regulations under the Sale of Food and Drugs Act.

(4) Every sale of pasteurized cream must be subject in all respects to the provisions of the Sale of Food and Drugs Act, the Health Act, 1920, and all regulations thereunder for the time being in force.

(5) The provisions of the Dairy-produce General Regulations requiring registration of premises as a manufacturing dairy must be complied with.

—*A. E. Morrison.*

The Fields Superintendent, Christchurch, reports that in the 1934 season an Annat farmer purchased 4 tons of certified Aucklander Short Top seed potatoes at £8 per ton and 2 tons of uncertified seed of same variety at £2 per ton. He planted them in the same field and the potatoes had the same treatment. The season was a dry one. The certified potatoes yielded 9 tons per acre and the uncertified 4 tons per acre. The certified potatoes returned the grower £36 per acre, and the uncertified £11 per acre.

Government Pedigree Stock Seed.—The Department of Agriculture will have available for sale following the harvesting of the 1935–36 grass and clover seed crops a limited quantity of Government pedigree stock seed of perennial rye-grass, white clover, and Montgomery red clover. This seed has been grown on contract for the Department from seed specially raised at the Plant Research Station, Palmerston North, and is available for purchase for the sowing-down of areas intended for the production of certified pedigree seed. All purchases of Government pedigree stock seed must be made through recognized merchants, and orders will not be filled unless they are received through merchants. Further particulars may be obtained from any officer of the Fields Division of the Department throughout the Dominion.

REVIEW.

Toadstools and Mushrooms and other Larger Fungi of South Australia: Part II. By JOHN BURTON CLELAND, M.D. Royal octavo, 184 pp., 4 coloured plates, 41 text figures. Government Printer, Adelaide.

THE work under review forms Part II of one of a series of handbooks on the fauna and flora of South Australia, issued by the South Australian Branch of the British Science Guild. It covers fungi belonging to the Polyporaceæ, Hydnaceæ, Clavariaceæ, Gasteromycetes, Heterobasidiæ, Larger Ascomycetes, and Myxomycetes known to occur in South Australia. Together with Part I, it is a noteworthy contribution to the scientific literature of South Australia, since it is the only accurate work published containing detailed descriptions of the fungi of this region. No less than 249 species are described, of which 116 are endemic to Australasia. Descriptions are carefully drawn, for the most part from collections made by the author, and, where more than one species occurs in a genus, are preceded by carefully arranged diagnostic keys. The work concludes with an index to species, genera, &c., described in Parts I and II, so that both may be bound into a convenient single volume.

The extremely reasonable price of 5s. is charged for each part, a price which places the work within the reach of all students of these interesting plants.

G. H. C.

NEW-ZEALAND-GROWN FRUIT (LOCAL SALES) REGULATIONS, 1935.

THE purpose of the New-Zealand-grown Fruit (Local Sales) Regulations, 1935, which came into force on the 19th December, is to consolidate the regulations hitherto in force governing the sale within the Dominion of New-Zealand-grown fruit of the kinds set out therein, and at the same time to provide standards for the grading of lemons. In addition, the opportunity has been taken to recast the standards for the grading of apples and pears to conform with the grading-standards laid down under the Government guarantee conditions with respect to export fruit.

The grading-standards for lemons are set out in detail in Regulation 8. The grading of lemons will not be compulsory except in the case of lemons sold in packages bearing the word "cured." The word "cured" or the words "not cured," as the case may require, must, however, be branded on all packages containing lemons for sale.

The increasing role of pig-keeping in our farming makes it particularly advisable that pig-keepers realize and apply in their practice the fac that there is a close correlation between general management and the incidence of diseases and disorders. Large numbers of pigs are rejected for export, and many of the rejections may be attributed to faulty management. Apart altogether from these rejections, which are serious in themselves, it has to be borne in mind that economic production of the pig-meat that is passed for export is intimately linked with good management, particularly in respect to feeding and accommodation.

—Annual Report, Director-General, Department of Agriculture.

For the second year in succession the sales of lucerne cultures by the Department have been sufficient to treat the seed required for the sowing of approximately 6,000 acres. The annual sowings of lucerne do not represent a net increase in the Dominion effective acreage: they are offset by the portion of previously established lucerne which each year goes out of production on account of its age, &c.; but the official statistics show that when allowance is made for this there is a steady increase in the Dominion acreage of lucerne. While this increase is not as great as the merits of lucerne would justify, it is probable it will be greater in the immediate future.

—Annual Report, Director-General, Department of Agriculture.

WEATHER RECORDS: DECEMBER, 1935.

Dominion Meteorological Office.

NOTES FOR DECEMBER.

DECEMBER was a remarkably fine month. For the holiday-makers there was abundance of fine and warm weather, yet at the same time the man on the land, generally speaking, got just the conditions he desired. Temperatures were much above normal, and though the last few days were relatively cool there was no really cold spell. Rainfall was, in general, considerably below normal, but this was no drawback after the wet and cold spring. One or two good falls met all requirements in most districts. A fairly humid atmosphere and an absence of wind were favourable features which tended to minimize any lack of rain. Stock are reported to be in good condition and lambs fattening well. There is abundance of feed, and much hay and silage were made under favourable circumstances. Crops promise to be much above average. Conditions were favourable for shearing, but it is still somewhat behindhand.

Rainfall.—Rainfall was generally above average north of Kawhia and Tauranga and in parts of Taranaki, but elsewhere, except for isolated patches, it was very much below. Canterbury had only about 25 per cent. of the average.

Temperatures.—From Nelson and Marlborough northwards temperatures were generally from 2 to 4 degrees above average. To the southward the departures were still greater, rising to over 6 degrees in South Canterbury and Otago and to 7 degrees at Invercargill. In these latter parts it was the hottest December on record, with the exception of that of 1934. Christmas was, in many places, the warmest recorded, and there were other very hot days.

Sunshine.—Nelson, Marlborough, and Canterbury had more than the average sunshine, but elsewhere conditions were fairly normal.

Pressure Systems.—The month was remarkable for the persistence of high pressure over the Dominion. Anticyclonic conditions prevailed continuously until the 12th, fine and warm weather being almost general throughout this period. There were slight disturbances on the 13th and 14th, which caused scattered light to moderate rains and a few thunderstorms, but mainly in western districts and from Taranaki southwards.

The only vigorous depression affecting the country during the month was one which arose from the remains of a tropical cyclone which developed in the New Hebrides on the 14th. This depression passed down the west coast of the North Island and thence across the South Island during the period from the 17th to the 19th. It caused general rains, which were of very great benefit. Except eastern portions of the South Island almost all districts had heavy falls, and in North Auckland there was some flooding. Inland from Oamaru, also, there were some isolated very heavy rains. A north-easterly gale did some damage in Auckland Harbour on the 18th.

After another period of anticyclonic weather a moderate depression passed rather rapidly eastward between the 28th and 30th. Widespread rains again occurred, with heavy falls in many places, but the rain was not so general nor so long continued as in the previous depression. Rather cool weather followed till the end of the month.

RAINFALL FOR DECEMBER AND CALENDAR YEAR 1935 AT REPRESENTATIVE STATIONS.

	December, 1935.				Calendar Year.	
	Total Fall.	Number of Wet Days.	Maximum Fall.	Average December Rainfall.	Total Rainfall.	Average Rainfall.
	North Island.					
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	4·30	5	2·33	2·63	70·48	54·31
Russell	12·49	6	7·70	2·55	100·59	49·94
Whangarei	4·19	7	1·50	2·99	80·54	60·51
Auckland	3·36	7	1·13	3·18	61·50	49·35
Hamilton	1·94	8	0·55	3·50	48·16	49·54
Rotorua	3·36	8	0·88	3·65	69·70	54·98
Kawhia	2·60	6	0·80	3·30	..	53·72
New Plymouth ..	4·98	7	1·43	4·21	77·27	59·70
Riversdale, Inglewood ..	5·35	7	1·63	7·48	115·88	104·17
Whangamomona ..	3·24	6	1·31	5·63	85·59	77·55
Hawera	3·27	6	1·23	3·25	58·03	45·21
Tairua	5·34	4	2·65	4·37	75·06	64·44
Tauranga	3·84	10	1·41	3·47	64·40	52·28
Maraehako Station, Opotiki	1·29	6	0·70	2·92	70·50	53·37
Gisborne	1·19	5	0·68	2·30	46·80	45·13
Taupo	1·95	8	0·70	3·12	53·67	43·87
Napier	1·62	8	0·71	1·94	51·38	30·08
Hastings	0·66	8	0·22	1·88	39·42	31·86
Whakarara Station ..	4·84	10	2·04	..	66·71	..
Taihape	0·65	9	0·19	3·26	37·17	36·72
Masterton	1·89	6	0·94	2·77	45·93	38·24
Patea	3·34	9	1·08	3·52	58·71	44·81
Wanganui	2·52	6	0·90	2·69	43·97	36·11
Foxton	1·75	6	0·87	2·64	36·08	32·51
Wellington	3·09	8	1·65	2·93	40·74	42·30
	South Island.					
Westport	3·44	8	1·48	8·45	88·25	96·80
Greymouth	4·26	16	1·02	8·65	91·36	101·55
Hokitika	4·16	11	1·17	10·37	105·00	114·94
Ross	5·21	8	2·00	12·05	111·65	135·49
Arthur's Pass ..	5·02	6	2·10	14·11	121·70	161·91
Okuru, South Westland	10·09	8	3·45	10·97	103·49	144·47
Collingwood	5·57	5	3·78	7·97	103·03	97·40
Nelson	3·69	5	2·30	2·96	47·96	37·82
Spring Creek, Blenheim	1·25	5	0·50	2·10	28·55	30·28
Seddon	0·87	6	0·52	1·96	23·00	24·80
Hanmer Springs ..	3·17	4	1·76	3·80	45·32	45·09
Highfield, Waiau ..	3·00	4	1·59	2·64	34·69	33·28
Gore Bay	1·65	5	1·01	2·57	28·58	31·27
Christchurch	0·52	4	0·36	2·46	22·07	25·13
Timaru	0·60	4	0·35	2·42	19·89	22·68
Lambrook Station, Fairlie	1·57	5	1·07	2·57	22·38	24·87
Benmore Station, Clearburn	1·24	6	0·53	2·34	22·79	24·64
Oamaru	1·17	8	0·27	2·25	19·09	22·01
Queenstown	1·33	3	0·96	2·51	28·86	30·50
Clyde	0·86	3	0·68	1·76	14·49	15·22
Dunedin	1·54	10	0·55	3·47	35·23	36·65
Wendon	1·67	9	0·73	2·82	31·36	29·96
Balclutha	1·01	5	0·43	2·56	29·65	25·62
Invercargill	1·51	14	0·32	4·00	43·77	45·65
Puysegur Point ..	6·08	14	1·27	7·17	83·16	85·26
Half-moon Bay ..	2·11	14	0·53	4·90	55·78	58·79